



# *International Federation For Systems Research*

**Proceedings of the**

## **Fourteenth Fuschl Conversation**

**G. Chroust** (ed.)

**March 29 -April 3, 2008  
Fuschl am See (Austria)**

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Institute for Systems Engineering and Automation  
Johannes Kepler University Linz, Austria  
gc@sea.uni-linz.ac.at

**SEA**....→

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**JOHANNES KEPLER  
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## **Welcome to the Fuschl Conversation 2008!**

Both 2005 (the First IFSR-Congress in Kobe, Japan) and the Fuschl Conversation 2006 created a new vision for IFSR position and goals in a continually more complex, more interdependent and more collision-bound world. The IFSR accepted this challenge. And thus it was quite natural also to employ the well-established bi-annual Fuschl Conversations to help the IFSR to achieve the new goals and challenges. As a consequence the topics chosen were more selected for their practicability and usability for the Systems Movement at large and for IFSR as one of the key players.

This volume summarizes the findings of the Fuschl Conversation 2008.

After a short introduction to the history of the Fuschl Conversations leading to 2006 the four team reports are presented.

Some overall information about IFSR concludes the volume.

The proceedings can also be read and downloaded via the IFSR's new homepage at <http://www.ifsr.org>. Many pictures of the Conversation, showing both the hard work and the ambience can also be found there.

Looking at these proceedings I am proud that we can show that IFSR – with the help of the Fuschl Conversation 2006 - will be able to even better serve the systems community and thus promote systems thinking.

*Gerhard Chroust (Austria)  
Secretary General IFSR  
Jan. 2009*

# Looking back at Fuschl 2008

Gary Metcalf (USA), Gerhard Chroust (Austria)

28 years is a long time for a small conference/workshop to survive. We can be proud that the Fuschl Conversations still exist and show their usefulness. .

When looking back on the history several phases can be distinguished<sup>1</sup> :

- The initial phase (1980 – 1994) which could be mainly seen as a *personal experience phase*. Participants attended the conversation without any attempt to disseminate afterwards their results to the outside world in a formal way. These conversations were driven by the charismatic personality of Bela H. Banathy. Topic centered on the general area of social design. The participants profited from Fuschl mostly themselves (Ch. Francois: “*When you leave Fuschl, you are a different person*”).
- By 1996 it was decided to give the Fuschl Conversation a little more structure and transparency. A formal Call-for-Participation and a participant selection procedure was introduced, accepting around 28 participants in 5 to 6 teams, still discussing various aspects of social design. A short version of the results was published soon after in the IFSR Newsletter, a more detailed report together with accompanying ‘think papers’ was published as proceedings. We may call it the *dissemination phase*.
- When Bela was unable to join us in Fuschl from 1998 onwards, his spirit kept the Conversations going but gradually the ideas got somewhat diluted, and we reached a ‘*diversification phase*’. Social Design was not the only focus any more. Also many participants discussed topics which were not really ‘theirs’. At the closing of the Fuschl 2004 Conversation a certain feeling of uneasiness about the validity and the relevance of the Conversation was felt.
- 2005: This development coincided with another change to the IFSR. Initiated by IFSR’s then President Jifa Gu, the IFSR Board decided to hold its first Congress in Kobe, Japan, in November 2005, together with our new Japanese member, the International Society of Knowledge and Systems Science (ISKSS)<sup>2</sup>. This congress will be remembered as a turning point in the history of the IFSR: For the first time IFSR was willing to really take a lead in the Systems Movement, we entered the *integration phase* for the Fuschl Conversations.
  - 2006: The vision of the IFSR’s new role could only be realized by achieving a consensus between our members and by an evaluation of the situation of the systems movement. This gave a new challenging purpose to the Fuschl Conversation: to provide a platform for representatives of our member societies and other prominent scientists to evaluate the state of affair in systems, make some conclusions for the future and to give guidance and direction to the IFSR and its members. We decided that the Conversation-style was the right tool and Fuschl the right environment to achieve our goal. For 2006 we choose topics which were relevant and strategic to the systems movement at large and to the IFSR in particular. We invited representatives of member organizations to suggest participants. The Fuschl Conversation brought numerous suggestions, ideas and actions plans for the future work of the IFSR. The findings and suggestions of Fuschl 2006 can be found in the proceedings<sup>3</sup>.
    - One major impetus was the recognition that IFSR needs a much more interactive and comprehensive Web-site. As a consequence – after some deliberations – Gerhard Chroust, the Secretary General, agreed to renovate website, using a different technology (DRUPAL) and on this basis provide a dynamic communication means for our member societies and for the Systems Movement in general. By November 2007 this new website (<http://www.ifsr.org>) became operational and is under constant improvement since. One of the major advantages of the new website is the accessibility of much of the information (all Newsletters, Fuschl Proceedings, pictures, etc.) to the general public in a central repository. But we all agreed that this 2006 Conversation was to be a singular event, not to be repeated the next time.
    - With 2008 we went a middle ground: We choose (finally) four topics which seemed to be in the center of concern for the systems movement in general but also to the participants. All topics were concerned with enabling the IFSR to perform better. We kept the traditional Conversation style. Again the Conversation was characterized by a strong involvement of all participants. In the Conversation we

<sup>1</sup> Metcalf, G. and Chroust, G., Fuschl 2006 - Aims and Objectives, in Metcalf, G. and Chroust, G.: Proceedings of the Thirteenth Fuschl Conversation, April 22-27, 2006, Inst. f. Systems Engineering and Automation, Kepler Univ. Linz, 2006, SEA-SR-13), ISBN 3-902457-13-9, pp. 6-9

<sup>2</sup> Gu, J. and Chroust, G., IFSR 2005 - The New Roles of Systems Sciences for a Knowledge-based Society, Kobe 2005, JAIST Press 2005, Japan - CDROM, ISBN 4-903092-02-X.

<sup>3</sup> Metcalf, G. and Chroust, G.: Proceedings of the Thirteenth Fuschl Conversation, April 22-27, 2006, Inst. f. Systems Engineering and Automation, Kepler Univ. Linz, 2006, SEA-SR-13, ISBN 3-902457-13-9, pp. 65

tried to enhance the panel discussions and the cross-team interactions, encouraging participants to join as 'guests' other teams.

Fuschl 2008 showed considerable difference to the 2006 Conversation. In 2008 operational and practical problems were in the foreground: "How can we achieve...", while 2006 was more concerned with long range strategic visions. Both Conversations however, established the IFSR as a high-level coordinative player in the Systems Movement and were very helpful in deciding on future directions. But we also recognized that we need more changes to keep the Fuschl Conversations sufficiently useful to justify their existence and the associated expenditure in time and money.

Bela Banathy envisioned that the preparation for a Conversation ideally begins as an outgrowth of a previous Conversation – or at least with many months of advance thinking and preparation. A topic is chosen by a team; individual input papers are prepared and distributed to allow the team members to further refine questions and to arrive at some shared understanding of the ideas and viewpoints of other team members. By the time the team arrives at the formal, in-person, face-to-face Conversation, a great deal of familiarity and background should already be established and the team simply moves into an intensive phase of work that has begun.

In reality in today's environment that kind of collaboration between professionals at great geographic dispersion and with much tighter schedules is difficult to achieve. Those difficulties were part of what had brought the Fuschl Conversations to a critical junction, and became magnified in many ways during the 2006 and 2008 Conversations – a reality that should be instructive for us going into the future. Modern ICT might be helpful, but not enough.

With these proceedings we try to convey a realistic and largely un-edited record of the Fuschl Conversation 2008. The style and the level of detail differ depending on the type of group. The reports in these proceedings should be considered as 'work-in-progress'.

## List of Participants

Due do some unexpected illnesses finally only 23 participants from 11 countries were able to attend.

Blachfellner Stefan	AT	stefan.blachfellner@indaba-consulting.at
Bosch Ockie	AUS	o.bosch@uq.edu.au
Chroust Gerhard	AT	gc@sea.uni-linz.ac.at
Clusella, Maria M. C	AR	mercedesclusella@gmail.com
Drack Manfred	AT	manfred.drack@univie.ac.at
Dyer Gordon	UK	gcd2@tutor.open.ac.uk
Herrscher Enrique	ARG	enriqueherrscher@fibertel.com.ar
Hofkirchner Wolfgang	AT	wolfgang.hofkirchner@sbg.ac.at
Horiuchi Yoshihide	JP	horiuchi@sic.shibaura-it.ac.jp
Ing, David	CDN	daviding@coevolving.com
Jones Jed	US	jed@jedcjones.com
Kalaidjieva Magdalena	BG	mk@bitex.com
Kiauta Marko	SI	kiauta.marko@amis.net
Laszlo Alexander	US	Syntony.Quest@usa.net
Laszlo Kathi	US	Syntony.Quest@usa.net
Leonard, Allenna	CND	allenna_leonard@yahoo.com
Löckenhoff Helmuth	D	loeckenhoff.hellk@t-online.de
Metcalf Gary	US	gmetcalf@interconnectionsllc.com
Ossimitz Günther	AT	guenther.ossimitz@uni-klu.ac.at
Ramage Magnus	UK	M.Ramage@open.ac.uk
Solomons Leonie	UK	leonie.solomons@gmail.com
Stepanic Josip	HR	josip.j.stepanic@fsb.hr
Wilby, Jennifer	UK	isssoffice@dsl.pipex.com;mfuw69@dsl.pipex.com

## Reflection on Fuschl Participation

Maria Mercedes Clusella  
International Institute Galileo Galilei  
Argentine Foundation for Talent and Ingenuity

*Right after the official opening of the Fuschl Conversation 2008 on Saturday March 29 I was asked to reflect on my experience because of having taken part in Fuschl 2006. This experience allowed me to adopt the "spirit" that guides me in this new opportunity to take part in FC 2008, with the commitment to communicate the outcomes to the community and the continent to which I belong.*

In the beginning of Fuschl conversations 2008 I want to contribute some reflections about the process of Fuschl conversations in which I participated two years ago. I hope these ideas help us to increase the value of the development, involvement and effects for the continuity of the Conversations process which have already been in effective action. This 14<sup>th</sup> conversation demonstrates it. And in a collaborative way we were able to design in these six days "contents" that should influence in the "continent" under the influence of IFSR, as a trans-generational communication tool, and as an instrument that facilitates the inner and outer IFSR communication (which means its trans-culturality).

From my culture I perceived Fuschl interchanges as benefits that enrich my criteria and make me able to come back to my country, to my community and feedback our own experience. I feel the need to do this due to my conscience that these experiences also belong to the community and that we have the responsibility to make them transcend with the immediate transfer, for the renewal and strength of our community.

I come to Fuschl with a tradition and heritage because the group to which I belong in Santiago del Estero, Argentina, has its own history since the seventies, together with GESI of Buenos Aires and with a direct link with Fuschl conversation, because Charles François always transmitted the Fuschl outcomes to us. Until this moment the four generations that constitute our institutional community weren't ignorant of the Fuschl outcomes. These allowed us to adopt a style and spirit to make systematic studies and systemic researches more creative and innovative.

These experiences and this new opportunity will open up my mind for the search of ideals which will continue to evolve for the education and development of the communities in which we live, as an ethic of interdependence.

In these intensive days of TRANSCULTURAL conversation, comprehended as a practice of interdependence, we dedicate our time and energy to understand each other and then to be understood so we learn from our diversity and appreciate that the strength and power come from our differences. I found open communication with ideas, beliefs and behaviors, although they were different from me. All these I accepted with the commitment to make a significant contribution to the large community.

I am one person of the community that during these years has received the Fuschl outcomes. So, I am proud to be part of it now again and I hope to be able to contribute with my perspective.

## Photos from Fuschl 2008

Photos of the Conversation are interspersed into the reports. A considerable larger gallery of photos can be found on IFSR's home page: <http://www.ifsr.org> -> **Photo Gallery!**



## Team 1: Informing the Development of Systems-Oriented Curricula at the University Level: The Systems Education Matrix

Ockie Bosch (AUS)  
Manfred Drack (AT)  
Yoshihide Horiuchi (JP)

Jed Jones (USA)  
Magnus Ramage (UK)

### Introduction

This paper proposes a tool called the Systems Education Matrix (SEM) for use in informing the work of developers of systems-oriented curricula at colleges and universities around the world. The SEM was developed by Team 1 at the 2008 IFSR Conversation held at Fuschl-am-See in Austria. The paper is loosely divided into three sections, covering respectively: an overview of the current state of systems education, a synopsis of the group process followed during the development of the SEM, and an explanation SEM itself.

### Context

In most educational, industrial, scientific and social contexts, in order to understand something better (e.g., an ecological system, an organization, a policy), we break it into parts and then study the parts separately (Ackoff et al., 2006). In this way, interdependencies and interactions between the constituent parts are overlooked, which are the very causes of complexity and dynamic behavior in systems.

The wide range of disciplines involved in addressing complex contemporary issues (e.g., climate change, sustainability of businesses) require the integration of diverse ranges of knowledge and skills. The ability to explore the complexity of interactions within the 'hard' system (the biophysical components) and within the 'soft' system (the interactions between the biophysical components, technology and people) requires a shift away from single disciplinary projects toward multi-disciplinary and inter-disciplinary research, and approaches.

To accomplish this, new ways of thinking are essential to manage the complex problems we are dealing with today. Systems thinking offers a way or 'method' with which to construct and explore inter-relationships at a variety of system levels (Bosch et al., 2007).

To achieve this, it is clear that systems education should be acknowledged as being in direct support of a science-based approach to helping today's society to deal with the complexities of contemporary issues. To serve this role effectively, systems education needs to be focused towards the various needs that exist. There is a need for systems specialists and theoreticians who can develop concepts, theory and tools. There is an even greater need for educating a wider spectrum of people in how to use these concepts and tools in solving complex problems. For example, statistical analysis is used as standard practice and is an integral part of all disciplines of science. Systems thinking, in contrast, is not (Bosch et al. 2007). In the same way that researchers do not all have to be statisticians, they also do not all need to be systems specialists.

This premise was the basis for Team 1's approach at the 2008 Fuschl Conversation. The members of Team 1 have focused on the nature of systems education that will be required to not only train systems specialists, but to make systems thinking and analysis an integral part of discipline focused research and management.

### *The Fuschl systems Education Team: Background, Context and Stated Goals*

In January of 2008, the member of Team 1 was asked to explore the "basic concept of systems sciences," and the Conference primer ask them to consider the following triggering questions:

- (A) What concepts must a person know in order to call him/herself a 'systems scientist'?
- (B) Can we establish an ontology of systems concepts using Charles Francois's encyclopedia?

- (C) Can we define a systems science body of knowledge?
- (D) What are existing / desirable University programs and courses – how much are they covering, compatible with (A) and (C)?
- (E) Given the fuzzy borders of systems Sciences would it be helpful to separate the field into LARGE subfields, similarly to e.g. informatics (practical, applied, theoretical).
- (F) Given that in Fuschl we cannot fully solve these questions, what is an appropriate road-map to achieve it, what should be the collaborators and what is the time frame?" (*IFSR Newsletter*, January, 2008)

Based upon these, the theme of Team 1's dialogue evolved as described below.

## **The State of Systems Education Today**

### ***Systems Education at the University Level***

Historically, the demand for systems education has been modest and there are only a handful of university-level systems education programs around the world. While the number of standalone systems thinking courses taught around the world is not small, the number of university-level programs or majors in the systems field is scant. There are two main reasons for this. First, the bulk of systems education to date has been focused on training specialists. This has naturally limited the potential population for systems education at both universities and among specialists at the professional level (i.e., internal and external corporate consultants, systems modelers, etc).

The second reason is related to the first, namely: the specialist focus has been accompanied by a relatively technical approach to systems education. This has left the impression that systems education is a technical subject suitable for engineers, scientists, quantitative ecologists and mathematicians and hence beyond the reach of other disciplines. This is reflected in the focus and language of most of the current text and reference books that are currently available. With the exception of a few and notably, *Systems Thinking and Modelling* (Maani & Cavana, 2007), the bulk of systems books are by-and-large hard to read and beyond the reach of most students, managers and policy makers.

The future growth of systems education will depend on how well systems educators around the world are able to relate systems thinking to topical issues and complex challenges managers and decision-makers are facing today. The list of these issues is large and growing daily: energy, food, sustainability, climate change, water shortage, and now credit crisis. The systems community can make a material contribution to the debate and resolution of these issues and hence should take a centre stage in these forums.

The systems field today remains largely fragmented. This is ironic for a field that claims to integrate other disciplines. Unless we are able to demonstrate to the world that system thinking is in fact an integrative discipline, we cannot convince the world to accept our precepts. This issue needs the close attention of the systems community.

University courses that teach principles of systems science without contextualizing them through case studies taken from the different areas of interest have little impact. This approach reduces demand for (and fosters an ignorance of the value of) systems education in later years when studies come to have the need for unraveling complex issues.

Universities around the world are addressing these issues in various ways. Some examples include:

#### ***Shibaura University MOT Program***

As of this writing, the Shibaura University Management of Technology (MOT) Program offers the following systems-related courses:

- (1) Social Systems Sciences ("Why" and "What" aspects of systems thinking.)
- (2) Qualitative Systems Analysis ("How" aspect of systems thinking)

A unique aspect of these courses is that they represent two completely different systems thinking schools. By contrast, it is often the case that systems courses offered from a university department tend to be clustered around one systems thinking school or another.

The “Social Systems Sciences” course is based on Idealized Systems Design by Russell L. Ackoff and Fred E. Emery at the Social Systems Sciences (S<sup>3</sup>) Department of University of Pennsylvania, circa 1984. MOT students often comment that this class helps them to question the question and identify the real issue behind the problem symptoms.

The “Qualitative Systems Analysis” course is based on the method developed by Howard L. Harrison and Robert J. Miller at the Sociotechnical Systems Design (STSD) Program at the University of Wisconsin-Madison, circa 1976. This course was derived from Systems Dynamics of J.W. Forrester, and is meant to help people make sense out of a complicated problem system using static and dynamic systems diagrams. “(STSD’s) purpose is to provide instructions for social science students in two areas... technological information (and) certain concepts and techniques used by engineers which can be of value to social-science graduates in pursuing their careers.” (“Sociotechnical Systems Design Program” Announcement, 1976).

### *Open University*

The Open University (OU) is Europe’s largest distance learning university, with around 200,000 students enrolled. For more than 35 years (most of its existence), it has had a program in systems, based in the Faculty of Technology (now the Faculty of Maths, Computing and Technology), with at least 30,000 students taking its courses. As with most other UK universities teaching systems, the approach of the systems group has always been highly pragmatic, oriented towards understanding systems and change management in organizations. In particular, the OU systems group has been highly influenced both by systems engineering and by Peter Checkland’s development of the soft systems methodology.

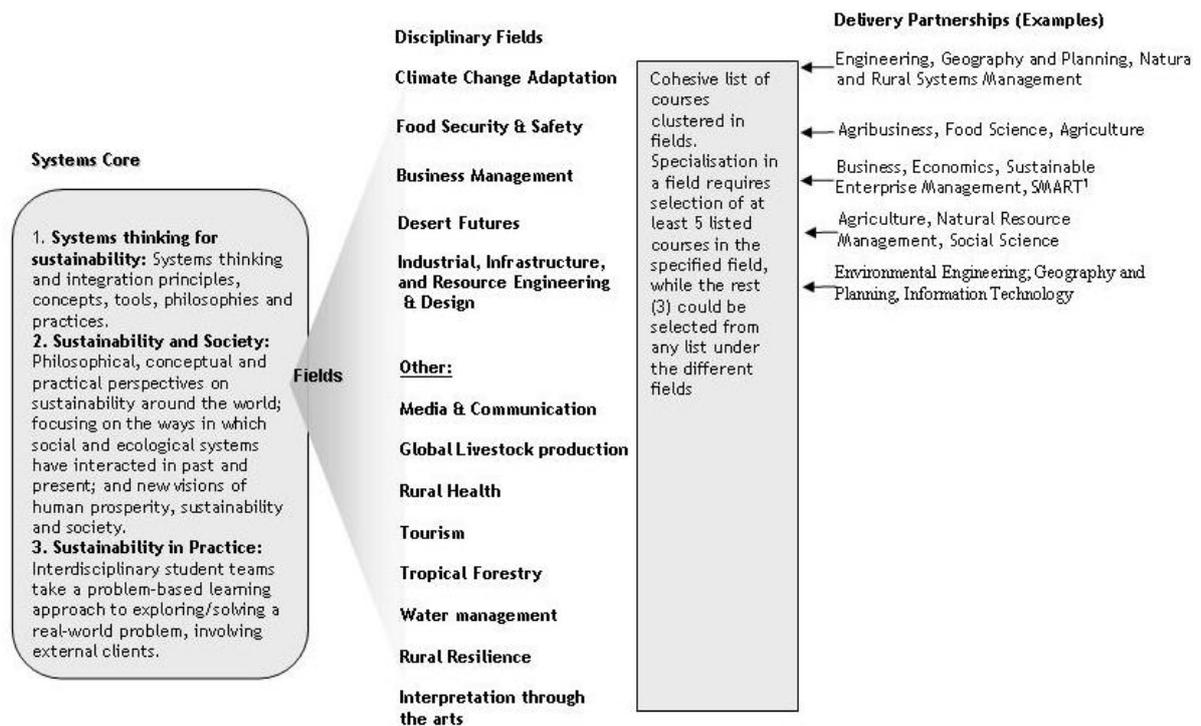
Teaching at a distance has the great advantage of reaching many students otherwise unable to access higher education, but is difficult in a subject such as systems where an apprenticeship model of education is often typical. The OU has instead emphasized the teaching of methodology, in a largely systematic form; and also the strong use of qualitative diagramming as a teaching tool which can create powerful models in a way that can both be taught and applied at a distance (Lane and Morris, 2001). Historically, the distance teaching through textbooks and television programs was supplemented by face-to-face tutorials and annual week-long ‘summer schools’; both of these methods have become less prominent over time, and the last OU summer school in systems was held this year.

The OU’s teaching of systems is conducted quite differently at the undergraduate and postgraduate levels. At the undergraduate level, the focus has been on a general systems approach – a set of common techniques applied across a wide range of disciplines. The OU has historically been oriented towards modular ‘courses’ rather than complete degree programs (six full courses being the requirement for an undergraduate degree), and for most of thirty years the offering within systems has been just two such courses – one at second level, the other at third level. The main goal of the second level course is to teach a set of core systems concepts, diagramming techniques and basic modeling. The third level course has a much greater focus on methodology and practice.

### *The University of Queensland*

The Master of Sustainable systems offered by the University of Queensland in Australia from 2010 (Bosch, 2008) is an example of a systems based postgraduate program that is designed to attract students from all faculties and disciplines across the wider university - from agriculture and science to engineering, business and health sciences (Figure 1).

Sustainable Management Alliance in Research and Teaching – a collaborative partnership initiated by the School of Natural and Rural systems Management to bring together some of Queensland’s leading business people with the ultimate goal of informing and enhancing innovative research and industry guided teaching in the field of sustainable enterprise management.



Core courses include “Systems Thinking for Sustainability,” which introduces systems thinking as a tool and scientific methodology for dealing with multiple domains and divergent interests and perspectives including natural-environmental, social-political, business-economics, and policy-governance. Decision making and policy formulation in this setting is complex and embeds uncertainty and distant time horizons, often creating unintended consequences, tradeoffs and compromises. This core course is designed to help students develop a systems (holistic) view of sustainability as well as gaining new tools and skills for dealing with its multifarious elements

Other core courses include “Sustainability and Society” which expands on the first by providing philosophical, conceptual, historical, and practical perspectives on sustainability around the world, focusing on the ways in which social and ecological systems have interacted in past and present; and new visions of human prosperity, sustainability and society. The capstone course “Sustainability in Practice” integrates system tools, theories and concepts learned in previous courses. It involves multidisciplinary group projects as the key component of the course.

### **Constraints, Challenges and Opportunities**

#### *Constraint: Complying with the Needs of Industry*

The revolution that is taking place regarding the integration of systems concepts into discipline specific courses is not only driven by the need to train systems scientists who can deal with the complex issues, also by the need to instill systems thinking attributes in our graduates.

Industry requires graduates that will not only have in-depth knowledge in the field(s) studied, but who also can display effective communication skills, independence and creativity, critical judgment and ethical and social understanding. Of particular importance is the ability to develop analytical frameworks that can be used to critically analyze complex situations, solve problems and make decisions for system improvements. Universities should play an active role in enhancing the educational experience of students by focusing on high quality programs and developing a high degree of work-readiness of graduates through incorporating courses that will enhance personal and professional skills. Systems approaches are important mechanisms to help achieve the attributes that industry wants from future graduates - for example, the ability to contextualize (systems thinking skills), to identify issues, develop strategies, managing projects (unravelling complexity and problem solving models), convey the

message (communication), the ability to build resilience and being adaptable (dealing with change and complexity), and to build effective networks and work in teams (personal and collaborative skills).

These issues create a significant pedagogical challenge in that current university education tends to be focused on discipline specific teaching which has no room for a wider systems approach. Didactic autonomous discipline based courses fail to foster a social networking culture that has been proven to enhance the process of deep learning, nor do they promote interactions with other students in other disciplines. To address this problem we need innovative curriculum designs and learning environments that address academic paradigms as well as industry requirements.

*Challenge: Defining the Proper Boundaries and Recipients of Systems Education*

System thinking may be taught in any university education program. However, systems education must take into account the different goals of university courses and programs. Most of the students will later work in fields where they need to apply what they have learned. They must be educated with knowledge they can use immediately, including with a basic thinking framework and perhaps several relevant system approaches or concepts. A few students, however, will become researchers themselves and hence need a more fundamental and theoretical background of system approaches. So the quality and quantity of system courses must be adopted to the specific programs. Wherever analytic approaches are taught, students should know that this is just one side of gathering knowledge that might be useful in applications and that a synthetic or systems approach is important too.

System thinking has a strong potential to serve various disciplines, including in the areas of problem solving and basic research. The range of system courses must be designed in a way so that students can use what they have learned from sense making to practical and theoretical mastery of systems. Explicit system courses will be necessary in some education programs. In others system knowledge can be taught implicitly, i.e. through application.

*Challenge: Addressing the Issue of Demand or Potential Demand for Systems Education*

Changing the status of systems thinking to the level of a “scientific method” provides an enormous and challenging opportunity for systems education. In order to reach and educate a larger population of systems thinkers our mental model and assumptions need to change. This will require forums and debates in conferences and open publications on the future of systems thinking education. (The ISSS 2009 conference will be a great opportunity to take this debate to the next level).

In the case of university education, a basic level of systems understanding could be achieved through a course at the undergraduate level that deals with systems concepts in a generic way, and allow students from various disciplines to apply these to their own field of study. This type of course is recommended for offering as university or faculty core courses that are intended to provide a broad understanding of the systems addressed by the students’ own programs and of the relationship between these and other systems affecting their operational environment. The core course should aim to broaden students’ horizons and expand their appreciation of complexity. Students should be made aware of the demand from employers for graduates that can operate effectively in a 21<sup>st</sup> Century knowledge society by continuously emphasizing the need for an analytical framework to help them to critically analyze complex situations, solve problems and make decisions. These are generic skills that can be applied to any practical or professional field of employment, regardless of the particular field of interest.

An additional focus of such a generic core course will be to assist students to start to develop some of the skills and attributes required for effective university undergraduate study and transition to employment. These include attributes such as effective communication skills, independence, creativity, critical judgment and ethical and social understanding.

*Opportunity: Knowledge Management/Integration and Problem Solving.*

“Decision Labs” are used at the University of Queensland (Maani, 2008) to increase awareness of the value of systems education. Individual students or teams are improving their decision making skills in simulated (virtual) environments using cutting edge computer gaming technology. The games are challenging and “fun” and introduce students to basic systems concepts and thinking. These three-hour

sessions serve as “discovery events” or “tasters” that encourage students to appreciate the value of systems thinking in their own areas of interest and to enroll for full courses in “Systems Thinking and Dynamics” that are offered at under and post-graduate levels.

Instilling basic systems thinking skills and exposing students to analytical tools, develop an awareness of the value of systems education. This will lead to greater demands for systems courses at postgraduate level and utilizing the tools and concepts in practice.

### *Opportunity: The Potential for a Formal Approach to Spanning Multiple Disciplines*

Can a systems approach be taught across a wide range of disciplines? As we have seen above in the examples from existing institutions teaching systems, the answer is both yes and no. There are also many examples of systems approaches that have a cross-disciplinary appeal (such as system dynamics), and the basic goal of the founders of both General System Theory and cybernetics was highly interdisciplinary.

Part of the issue perhaps is that there is more than one kind of systems approach. Several authors have discussed the multiple schools that existing within the broad banner of systems thinking. For example, Ramage and Shipp (forthcoming) present seven traditions of systems authors: early cybernetics, General System Theory, system dynamics, soft and critical systems, soft cybernetics, complexity theory, and learning systems. Each of these traditions has a strong amount of commonality, and a certain overlap with other traditions, but also a considerable amount of difference – for General System Theory, the open system concept is paramount, whereas the feedback loops that are so crucial to cybernetics only really work in a closed system.

So one key aspect of teaching systems across multiple disciplines is to recognize which form of systems is being talked about, what are its antecedents and its implications. It is unrealistic to expect a unified approach across all the different systems traditions, and when a university (including those listed above) teaches what it terms ‘systems,’ the selection of concepts and techniques is highly contingent on the experience of the faculty involved. Nonetheless, through a sense of the range of different perspectives involved, we can gain a clearer appreciation of the benefits of different systems approaches across multiple disciplines.

### **Key Learnings from Past Research in Systems Science**

#### *Quotes and Key Ideas from Systems Luminaries*

“In the second stage (of evolution), easier-to-apply *indexes* that correlate highly with expert judgment are sought . . . The third stage of the evolution is the development of idealized operational definitions and measures of the properly involved . . . Very few of the so-called measures in the behavioral sciences have gone beyond the second stage of this evolution.” (Ackoff and Emery (1972), p. 159) The same could apply to systems education; namely, very few systems education program are in the idealized state of the third stage, while there are a good number of the second stage systems education programs. Ideally, a systems education program should be run as a purposeful system.

“(I)t is not nearly as important that a student learns any particular subject as it is that he learns how to learn and how to enjoy doing so . . . (S)tudents should be free to design their own curricula . . . It is at least as revealing of a student’s quality to evaluate the curriculum he has designed as it is to evaluate what he has gotten out of it.” (Ackoff (1999), pp. 163-64) Ideally, systems education departments should be an open, purposeful system in which students can design their own learning ends, and not just receiving courses for pre-fixed goals by the department.

Ackoff et al established the Social systems Sciences (S<sup>3</sup>) Ph.D. Program at The Wharton School of the University of Pennsylvania (1974-86) as an interactive, self-learning program for the students, as an idealized systems design of higher education. S<sup>3</sup> was a bold attempt to advance social systems sciences as a scientific discipline as well as practical problem-solving method for real-world problems, such as designing educational systems, information systems, management tasks, etc. An extraordinary feature of the S<sup>3</sup> is that the Committee of the Whole Meeting, with each faculty member, student and administrator cast one equal vote, made decisions about S<sup>3</sup> policies and operations. Also, at S<sup>3</sup> admissions was handled by student-faculty admissions committee.

### *Past Insights that Warrant Further Investigation*

Start systems education from early childhood, continue it through elementary education all the way to the high-education. Start systems education when children are very young. Systems thinking could be natural talent of children. (Horiuchi (2003), and Banathy (1996)).

Merrelyn Emery states, "I think there's a lot of groundwork that needs to be done in getting some open systems principles built into the education system right from the start and to get away from this 'top-down' teaching which has been dominating our concept of education." (Barton et al. (2004) p. 25)

### *On the Importance of Remaining Inclusive of Pluralistic Views*

There are various systems approaches, such as those of Ackoff, Banathy, Checkland, Emery, etc. Systems education departments tend to focus on a single systems approach. Each systems thinking approach is holistic and complete unto itself. And yet, each systems approach is unique and different from the others. Hence, it is desirable to include an introductory course consisting of an overview of various systems approaches before going into one specific systems thinking approach.

Merrelyn Emery states, "I don't think that there *is* a systems community. There may be several and they don't seem to have a lot of understanding of each other...." (Barton et al. (2004), p. 26) Bob Flood adds, "Ironically I think in the wider span of the systems movement there is a lack of tolerance between different schools of thought and I think that's very destructive." ((Barton et al. (2004), p. 26)

### **Process Overview of the Fuschl Systems Education Team**

The semi-structured dialogue process which Team 1 followed during the development of the SEM over a four-day period may yield some useful insights into the origins, nature and purpose of the SEM itself. Therefore, a brief overview of the group process that Team 1 followed is covered below.

In terms of group process, Team 1 went through a fairly normal evolution in terms of group dynamics in a dialogue situation, oscillating between times of relative harmony and relative chaos. Through a strong spirit of determination and the effective use of experimenting with different dialogue tactics at points when the evolution of the process seemed to get stuck, Team 1 was able to produce an outcome that was satisfying to most or all members. Here are a few highlights of the process:

#### *Phase I: Engaging Each Other (Day 1)*

Team 1 took a pragmatic, structured approach to the dialogue experience. During the first session, two of the group members who were experienced with a particular type dialogue process explained their views of the concepts of generative and strategic dialogue to the rest of the group. The group then took turns explaining their input papers in their own words. This led into a generative dialogue session whereby the group explored the question of "What is quality education?" The generative dialogue session allowed the group's member to surface their own assumptions and values about what "quality education" meant to them.

#### *Phase II: Two Key Insights (Day 1)*

The group then shifted gears into a mode of strategic dialogue. This transition took place as the group began to formulate its collective goals for the Fuschl dialogue event. The agreement was to create, within the span of the 4-day Fuschl dialogue event, an output paper that would serve as an attempt to collectively respond to the pre-conference triggering questions. During this phase of strategic dialogue, two key insights began to emerge: 1. There is a need to develop and categorize multiple systems education curricula in order to serve different students who have varying needs and goals; 2. It would be useful to identify the range of systems concepts (e.g., autopoiesis, feedback, homeostasis, etc.) such that each can be properly matched with each curriculum category.

#### *Phase III: Making a First Attempt at Classification (Day 2)*

After the two key insights emerged, the group soon developed a diagram in order to categorize the types of systems curricula required. The diagram contained two primary categories: “integrated” and “systems knowledge per se.” The “integrated” category was further divided into two sub-categories: “to aid in work readiness” and “learning in the context of a given discipline.” Meanwhile, the “systems knowledge per se” category was further divided into the sub-categories of “for basic understanding” and “for mastery.” A fifth sub-category was also added to the diagram: a pre-university “intro to systems” course. This 5-sub-category diagram came to be known unofficially as the systems Education Blob.

*Phase IV: Hitting a Wall and Changing Tactics (Day 3)*

Once the systems Education Blob was conceived, the group set as its next goal to generate and then classify examples of commonly-recognized systems concepts that could be fit into each of the systems education categories created in the Blob. The list was meant to be a “starter list” that could be augmented at any time in the future by individual practitioners in order to create a more expansive list of systems concepts. The group generated 76 systems concepts at that point. At this point in the process, the group hit a figurative wall in terms of its progress.

*Phase V: Breakthrough (Day 4)*

Team 1 achieved a breakthrough of sorts when it gave up on the idea of trying to find a way to rigorously classify systems concepts as previously desired. For the remainder of the dialogue event, the group shifted its focus, eventually producing a derivative of the Blob: the Systems Education Matrix. The matrix organized the systems education landscape into two main dimensions: the *depth and type of systems knowledge required*, and whether systems concepts are taught *per se* or rather through application within one or more specific disciplines.

**An Overview of the Systems Education Matrix**

*Structure*

The structure of the System Education Matrix (SEM) is given by its two axes. As the horizontal axis is divided into three areas and the vertical axis into two areas, the matrix results in six distinct cells. Each cell maps a particular systems education program. In the following the axes and the cells are described in detail.

*The Two Axes of the SEM*

Through the above described process, we came to realize that differences in systems education are based on two main axes: the depth and type of systems knowledge required (from sense-making over practical mastery to theoretical mastery), and whether systems concepts are taught *per se* (generic) or rather through application within one or more specific disciplines (discipline-integrated). The result is the Systems Education Matrix, which -- according to the two axes -- identifies six types of recipients of systems education. The table below illustrates the results.

	<b>1. Sense-Making</b>	<b>2.1. Practical Mastery (with ability to add to the knowledge base)</b>	<b>2.2. Theoretical Mastery (with ability to practice)</b>
<b>A. Discipline-Integrated</b>	e.g., horticulturalist, accountant	e.g., systemic horticulturalist	e.g., creator of knowledge within systemic horticulture
<b>B. Generic</b>	systems student	systems practitioner	creator of systems knowledge

In the columns the different categories of depth and type of systems knowledge are depicted. The capacities which apply to people who would receive education at the levels defined by the three columns are:

1. *Sense-making*: This involves having the ability to use basic systems concepts to make sense of phenomena, objects and processes in the world. This includes for example the capacity to:

- a. see things holistically
- b. understand interconnectedness
- c. recognize the interests on stakeholders representing one or more interacting systems
- d. identify underlying problems rather than symptoms

2.1. *Practical mastery (with ability to add to the knowledge base)*: This relates to having the ability to competently use or apply systems concepts for research or practice. The ability to expound upon or teach systems concepts to others. This includes for example the capacity to (items included above, plus):

- a. be creative in problem solving
- b. effectively manage messy, ill-defined situations
- c. adapt effectively to changing environments
- d. apply critical reasoning within multiple levels
- e. effectively intervene in problematic situations
- f. apply systems design approaches
- g. facilitate integration across disciplines

2.2. *Theoretical mastery (with ability to practice)*: This refers to being in a position to add competently to the body of systems knowledge (viz., philosophy, theory, methodology, and praxis), as well as areas of practical application in specific contexts. This includes for example the capacity to (items included in 1. *Sense-making* above, plus):

- a. integrate knowledge across disciplines
- b. apply critical reasoning within multiple levels
- c. effectively understand changing environments
- d. deeply understand multiple systems approaches
- e. refine and/or develop new system approaches
- f. facilitate connections between multiple systems theories and practices

The two **rows** are distinguished by the width of scope to which the system approaches should serve; i.e. if the graduate student should work in a distinguished discipline or rather beyond the boundaries of a discipline. The capacities of the rows include:

A. *Discipline-integrated*: This is having the ability to integrate systems approaches into one or more disciplines or areas of application. This includes for example, the capacity to:

- a. understand how their field of interest fits into the bigger picture
- b. deepen their understanding of their own discipline or area of interest by introducing systems concepts

B. *Generic*: This concerns having the ability to understand, apply, and relate systems concepts in multiple contexts and/or to add to the systems knowledge base. This includes for example, the capacity to:

- a. develop a broad knowledge of systems approaches
- b. identify meaningful and potentially useful patterns among multiple disciplines or areas of knowledge
- c. develop potentially useful, systems-oriented theories, methodologies and techniques which can be applied in more than one discipline

### *The 6 Cells of the SEM*

In the six cells of the table the different goals of systems education are reflected. Each cell corresponds to a basic type of systems education, i.e. distinct education programs a university might want to offer their students. A detailed description of each of the cells, from A1 in the top left corner to B2.2 in the bottom right corner, together with examples of potential participants is given in the following.

A1 – Discipline focused with ability to use basic systems concepts to make sense of phenomena, objects and processes in the world.

A basic level of systems understanding could be achieved through a course at undergraduate level that deals with systems concepts in a generic way, and allow students from various disciplines to apply these to their own field of study. This type of course is recommended for offering as university or faculty core courses that are intended to provide a broad understanding of the systems addressed by the students' own programs and of the relationship between these and other systems affecting their operational environment. The core course should aim to broaden students' horizons and expand their appreciation of complexity.

An additional focus of such a generic core course will be to assist students to start to develop some of the skills and attributes required for effective university undergraduate study and transition to employment. These include attributes such as effective communication skills, independence, creativity, critical judgment and ethical and social understanding.

A2.1 – Discipline-Integrated, with ability to competently use and apply systems concepts for research or practice.

The educational programs to develop this type of competency could be available at both under and postgraduate (Masters) programs. An undergraduate example is the Bachelor of Applied Science at the University of Queensland, Australia (see above) which develops an integrated and systems approach to management and policy decisions about the multiple uses of agricultural land, rangelands, forests, water, and marine resources. The design includes a systems core of integrative courses in natural resource systems, economics, social science, management, and policy; and a range of quantitative and qualitative skills and tools for systems thinking, identifying leverage points and systemic interventions, systems dynamics and modeling, problem solving and development of decision-support systems. Clusters of discipline focused electives provide students with an opportunity to apply the systems approaches to their specific area of interest (e.g., Tropical Forestry, Resource Economics, Coastal Environments, Natural Resources, Socio-Ecological systems, Rural Development, Indigenous Perspectives, Mining, Desert Futures).

A2.2 Discipline-Focused, but in a position to add competently to the body of systems knowledge and theory

People who are trained in this area are in the position to extend the systems knowledge in a certain discipline or several disciplines. They are working on the concepts and approaches which are used in the domain of A2.1. During the training theoretical mastery is achieved through higher degree research in post-graduate education. Students must profoundly understand the disciplines they are dealing with and also the advantages and shortcomings of various systems approaches in order to perform research and enhance the theoretical knowledge base.

B1, B2.1 & B2.1 Generic

At present, the generic field is quite limited, as there are only a handful of universities around the world who train systems generalists. Nevertheless, to make a real impact, the systems community should not only focus on systems education for specialists. While we need systems theoreticians and researchers, the key leverage is not to make 'systems' a mainstream science, but rather to integrate systems education into mainstream disciplines and degrees (the "A" cells in our matrix). Indeed, some generalists are needed who can take into account the system approaches within several disciplines and who are able to deal with the bigger pictures of the situations they encounter.

People fitting the B1 cell would be a student of systems science who are in the position of making sense of problems in various disciplines and between disciplines. The knowledge she/he gained allows for quickly finding key issues that are not obvious to people trained and operating only in single disciplines.

Somebody trained in the B2.1 field has a broad knowledge of system concepts and approaches that can be practically useful in various areas. How to apply those concepts and approaches is known in detail. This also includes the ability of working together with different stakeholders and the ability of guiding the work process.

People working in the B2.2 field are able to conduct research on a generic conceptual or theoretical basis. Thereby the systems knowledge base is extended. Here also approaches that are useful in one

area can be checked to find out if they are useful in other areas too, or whether there is a potential to generalize them. This is the domain of PhD students and researchers.

The generic fields of systems education might be compared to the teaching and research for instance in the theory of probabilities or statistics. A B1 statistician would be an undergraduate student of statistics; a B2.1 statistician would be somebody who is able to apply the broad knowledge of statistical concepts to a wide range of problems; and the B2.2 statistician would be somebody who is working on the concepts themselves. This simile might help to further develop generic systems education programs.

### *How the SEM can be Used*

The Systems Education Matrix can serve as a useful tool for educators charged with designing new university-level curricula that effectively integrate systems concepts and/or teach those concepts explicitly. The matrix undoubtedly stands to be further improved upon and refined, but it can be potentially used as it exists in its current state.

The descriptions of the different types of systems education required (and acknowledging that these differences do exist) could serve as useful guidelines to develop educational programs that will comply with the needs of the different types of students. It would further be useful to use these cells as guidelines to map the relevant systems concepts that would contribute to the development of the skills that would be required and be of use to the different types of students. Although such a generic mapping of concepts could be valuable, this task should rather be left to individual educators within the contexts of their own disciplines. It is also important to recognize that different universities (and study programs) specify different attributes that will be expected from their graduates. These should be taken into account in the development of course content and curricula to ensure that the systems education will be meaningful. This will not only lead to students accepting the value of systems thinking and tools as an integral part of their disciplines (as in the case of statistics), but also increase the demand for systems education.

It should be acknowledged that, although the systems content of courses is of utmost importance to achieve the goals of systems education, the quality and mode of delivery is equally important (Maani, 2004). "Capstone courses", in which students have the opportunity to integrate the tools, theories and concepts they have learned in real world problems involving multiple dimensions.

### **Questions for Future Iterations of the Ongoing Dialogue on System Education**

There remain a number of aspects of the issue of systems education to be explored. For example: What are the goals of systems education? Each systems education program needs to define for itself which elements of "systems education" it will teach. For example: Systematic (i.e., being comprehensive, consistent and deliberate in one's method) versus systemic (i.e., taking into account the nature and potential impacts of multiple dimensions of a system and its environment), design versus science, and, design versus art. (derived from Banathy (1996)). Is the program to provide an overall picture of systems thinking? Or, is it to be focused on a particular systems approach? Is the program about systems thinking itself, or is it to be taught in a systemic way by employing systems thinking techniques? "We have shown that the maturation (of systems thinking) involves both conceptualizations about systems and practical engagements with systems (or, alternatively, with fields construed in systemic terms.)" ((Barton et al. (2004), p. 31)

Ideally, those former students who have learned systems thinking should be able to facilitate communication among various disciplines. Also, they should be able to identify the real, underlying problems, synthesizing various disciplines.

The next step in this dialogue seems to be to define the term "systems education" and to design it from an idealized design perspective before going into the specifics of elaborating upon the details of the matrix. We could define two ideal images: (1) A purposeful systems-education system to educate systems-science generalists, and (2) A purposive systems-education system to educate specialists working in non-systems-related fields to have a deeper, fuller understanding of systems thinking. Such an idealized systems design process could take up another full conversation cycle.

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## Topic 2: The trajectory of systems research and practice

**Reporter:** David Ing (CDN)  
Allenna Leonard (CDN)  
Gary Metcalf

Leonie Solomons (UK)  
Jennifer Wilby (UK)

For this Fuschl meeting in March 2008, a group was formed based on a call for individuals with experiences in both (a) systems research and practice, and (b) applications in industry, academia and/or public policy. All of the participants in Team 2 have exercised systems thinking applied in the social sciences, both in research/educational contexts and in applied/practice contexts. In the discussion, we shared a rich base of collective experiences working in multiple countries across four continents.

In retrospect, the conversation drew out insights in three areas:

- 1. Where does systems knowledge figure into the practice of social science practitioners?
- 2. How is systems knowledge applied with domain-specific knowledge?
- 3. When are domain-specific issues providing entry points into which systems knowledge becomes valuable?
- 4. How is the nature of systems knowledge coevolving with institutions (public, private, not-for-profit) and technology (wikis, blogs, voice over Internet)?

This report concludes with a reflection on the conversation process itself, in the setting of Fuschl.

### 1. Where does systems knowledge figure into the practice of social science practitioners?

Systems knowledge may be neither necessary nor sufficient for success in social sciences. The individuals participating in this conversation, however, found it sufficiently rewarding to dedicate the better part of a week to shared learning. In the discussion, five different trajectories were described, centering on an understanding of systems.

#### 1.1 A systems perspective can help in understanding how individuals and organizations do and don't change

One participant consults with individuals and organizations, often in situations where people are caught, and are seeking an alternative path out. A systems perspective is helpful as an internal mental model, to sort out how people and organizations are able and disabled in changing themselves. The internal mental model may not be specifically externalized to those receiving the advice, as they may or may not have the interest or capacity to appreciate detailed insights into how their world works. For this practitioner, systems knowledge tends to lean more towards understanding, and less towards named systems methods

#### 1.2 A systems approach can be applied for problem-solving, in moving from current practices

A second participant took a more pragmatic stance, applying systems concepts and language as a way of bridging people, tools, and the world. A systems approach is used as a complement to a theory of practice combining reflexive sociology (i.e. Pierre Bourdieu) and phenomenology (i.e. Hubert Dreyfus' reading of Martin Heidegger). In contrast to an idealized approach (i.e. future state <-- current state) often used in business organizations (in the style of Russell Ackoff), this practitioner has found that roadmaps (i.e. current state --> future state) are more helpful in enabling progress. Concepts and language consistent with a systems understanding are used with laymen, with more theoretical and philosophical explanations brought to bear offline with the very few individuals interested in the "why" in addition to the "how".

### **1.3 Systems theory can be a foundation for finding patterns that may be reapplied elsewhere**

A third participant orients towards a more theoretical view of systems, as a way of seeing a bigger picture, with interconnections and inter-relationships between parts. Patterns within one domain can potentially be lifted and reapplied in another context. This participant deals less in active interventions, and more in educational settings. Systems theory tends to be more explicit in a pedagogical setting, as knowledge is being transferred both to potential future educators as well as practitioners.

### **1.4 Systems thinking can aid in formation of a desired end, with reflexivity into premises**

A fourth participant applies systems in the interest of getting things done, and a method for deciding what to do. The joint future state of the group being facilitated is a discontinuous change from the current course and speed that exposes the varying interests of multiple parties. Joint learning leads to the parties -- at least those open to reflection -- examining and re-examining underlying premises and assumptions. This participant is most interested in moving the group towards a better future state as a primary concern, de-emphasizing the explicit analysis of motivations and "why" each party is coming to the agreement.

### **1.5 Systems relations can enable integrating multiple perspectives**

The fifth participant works in advocacy, making regulations actual (i.e. enforced) rather than just espoused. This requires understanding the backgrounds and interests of multiple parties, with a standpoint that none of these views can or should be invalidated. Establishing policies is an art where individuals are guided towards doing what's right, rather than pursuing courses of action in complete opposition towards ultimate purposes that the group seeks to achieve. Within these contexts, a de-emphasis on the parts and a focus on the relationships calls for a systems perspective, in which connections are sometimes evident and direct, and sometimes complicated and indirect.

### **1.6 Across social science practitioners, systems theory may or may not appear explicitly**

The sharing across the varied backgrounds of this group of social science practitioners led to a discussion about how explicitly systems theory should be invoked in different situations. It was generally agreed that people undergoing change may only require an implicit common understanding. That common understanding may be supported by a boundary object (e.g. a written agreement), to which each party may give a different interpretation when asked to explain its content. Within each personal understanding, some individuals may have developed a more systemic appreciation of the circumstances than others. Simpler and superficial familiarity with an agreed path forward takes the common language at face value, and action can proceed without a perceived need to pursue additional details.

Systems theory provides a language and set of concepts that can ensure rigour and clarity amongst those immersed in the field. Practitioners can be competent in naturally exercising systems principles at the same time as they are inarticulate about how and why they have chosen specific actions. If the practitioner is articulate in systems language and context, the appropriateness of sharing that language depends greatly on the situation. To one layman, systems language may be descriptive and enlightening; to the next layman, it can be confounding and threatening. Systems thinking may therefore be obvious or inobvious to outside observers, as well as those directly involved within an intervention.

## **2. How is systems knowledge applied with domain-specific knowledge?**

At regular periods during the four day meeting, the Fuschl conversation teams came together to each debrief others on progress and ideas that they were discussing. A presentation of Topic 1: "Basic Concepts of Systems Sciences" led to a matrix that that team eventually de-emphasized, but we reinterpreted with great applicability for our subject. While their focus was on "basic concepts", our orientation towards applications by practitioners led to findings on explicitness and roles.

## 2.1 When integrated with domain knowledge, systems knowledge can be categorized in levels of explicitness

The roles and paths of individuals into systems thinking come from two paths:

- (a) individuals whose interests are primarily in a domain, applying systems knowledge as a means to cross disciplines; and
- (b) individuals whose core interests are in systems, e.g. looking for isomorphisms applicable in an interdisciplinary or transdisciplinary frame.

Our conversation centered on the former. The explicitness of systems knowledge is reflected in the sharpness of concepts and language in these practitioners, at three levels.

- (1) systems knowledge use for sense-making and applied implicitly, with a low degree of rigour in systems definitions and language, e.g. "emergence" has meaning in common language not entirely inconsistent with systems definitions;
- (2) systems knowledge applied practically in the situational sense, e.g. "coproduction" has a meaning in the Hollywood film industry that makes the use of the systems term problematic; and
- (3) systems knowledge mastery, where the practitioner uses systems concepts and language explicitly within the discipline, e.g. "purpose" used in a business workshop, completely consistent with the systems definition.

Crossing these two dimension modified the matrix developed by Team1, and led to conversations in Team 2 about "A1", "A2" and "A3" contexts and roles.

	Explicitness of systems knowledge -->		
	1. Systems knowledge implicitly applied in sense-making	2. Systems knowledge explicitly applied practically	3. Systems knowledge mastery, at theoretical depths
A. Systems knowledge integrated with domain knowledge (i.e. multidisciplinary)	A1. Systems concepts applied within a domain by a practitioner, possibly without a systems vocabulary	A2. Systems concepts applied within a domain by a practitioner, with the explicit use of systems vocabulary, possibly adapted to disciplinary language	A3. Development of new systems concepts and language driven by practice within a domain
B. General systems knowledge, developed in a pure sense (i.e. interdisciplinary / transdisciplinary)	B1. (not developed within Team 2's conversation)	B2. (not developed within Team 2's conversation)	B3. (not developed within Team 2's conversation)

While the participants in Team 1 generally focused on increasing the level of expertise and systems knowledge (i.e. moving towards the right in the matrix), our discussion saw an appropriateness for applied levels (i.e. towards the left). While it is important to have masters who can continue to develop theory, widespread application of systems knowledge in practical situations requires adoption of language and concepts amongst a larger population.

## 2.2 The appropriateness of articulating systems knowledge can vary by the role played in engagement

The range from theoretical mastery to implicit sense-making was evident in the our contextual histories. The domains of business (i.e. information technology consulting) and peace negotiations (i.e. conflict in Sri Lanka) served as concrete examples to illustrate the matrix.

An example consistent with the above distinctions parallels roles assigned in the design and delivery of engagements, within IBM Global Services

- A1: a *consultant* takes accountability for producing work products and deliverables to specification, e.g. a "business direction" artifact predefined as a work product, rather than a "strategy" artifact where the purest definition of strategy can include deception, which isn't helpful in constructing information systems;
- A2: a *methodology exponent* takes accountability to assist joint teams of clients and consultants with the selection of appropriate modules for execution within an engagement, excluding other work as out of scope so that engagements goals can be achieved within budgets; and
- A3. a *methodology author* takes accountability to develop reusable -- rather than situational -- engagement models including work products and technique papers, as modules within an enterprise system of methods.

The economics of delivering consulting engagements and the practicality of training practitioners to varying levels of expertise -- across multiple domains of knowledge -- means that a desirable target depth of systems knowledge can be specified.

- An A3 *expert* seeking generality across multiple engagements can conflict with an A1 practitioner's goal to satisfy the immediate desires of the client at hand.
- An A2 *exponent* increasing rigour in a consulting engagement can be counterproductive to A1 practitioners, introducing questions that slow down the immediate progress on work at hand.
- An A1 *practitioner* producing one-of-a-kind deliverables inconsistent with the larger knowledge system undermines easily replicability, with the downstream impact of increasing the cost of replication in future engagements..

These distinctions led to questions about the appropriate depth of systems knowledge for facilitators and participants in the context of peace and conflict talks.

- Do the *front-line negotiators* meeting face to face need an A1 depth or A2 depth of systems knowledge?
- For *leaders responsible for forming negotiation teams*, can a set of A2 essential systems concepts or principles be developed?
- For an *expert in the peace and conflict domain* with a mastery level of systems knowledge, which systems concepts have already been developed, and where would greater articulation be helpful?

Systems knowledge can be consistent across all of the roles, but the tensions between rigour and relevance may manifest in varying vocabularies and behaviours in systems practice.

### **3. When are domain-specific issues providing entry points into which systems knowledge becomes valuable?**

While the participants in this conversation clearly possess systems knowledge, its applicability is situational. In many cases, disciplinary knowledge is appropriate and sufficient. When expertise or concepts beyond disciplinary boundaries seems inadequate, an entry point for systems knowledge opens. Experiences with applications of system thinking were discussed in four domains:

- systems studies through a history of science approach (i.e. systems of system concepts and systems researchers);
- graduate-level education (i.e. master's programs in management and engineering);
- peace and conflict situations (i.e. negotiation as alternatives to civil war and struggles between ethnic groups); and
- system envisioning of future state business organizational and technology alternatives and options (i.e. business architectures)

These domains each have large bodies of disciplinary knowledge commonly used by practitioners within their fields. Ways in which systemic foundations complement disciplinary knowledge were discussed.

### **3.1 Continuing professional development of systems knowledge was difficult from a conceptual entry point, and easier as history of science**

Four of five participants of this Fuschl Conversation had previously participated in an ongoing, open-ended research project called the *Systems Sciences Connections Conversation*. This series of meetings was initiated by senior members of the ISSS, with the goal of improving an appreciation of systems science content at postgraduate levels. These meetings have a specific agenda to develop systems knowledge amongst ISSS officers, to the exclusion of planning and operating society matters that can be conducted in other settings.

In preparation for this initiative, a survey of books collecting systems articles was [posted on the ISSS web site](#). In the inaugural two-day meeting of this group in October 2007, the group attempted to coalesce around a set of systems concepts. Frustration ensued as the discussion became too diffuse, flitting from one topic to another. As illustrated in the *International Encyclopedia of Systems and Cybernetics* (Charles Francois, editor), the systems movement has had the benefit and burden of open exchanges of ideas and definitions. An entry point of "relevant" systems concepts proved to be too situational when faced with the extended history of thinking that has made up systems movement.

Subsequent conversations has been more successful with history of science as an entry point. While libraries and booksellers provide access to the writings of specific authors in the systems movement, many of these luminaries developed their bodies of work contemporaneously with each other. In a very few cases, archives may contain letter or communications between these systems figures, but the understanding of convergences and divergences in viewpoints is underdeveloped. This project had adopted the view that -- at a postgraduate level of understanding -- the ideas and work of systems scientists can not be separated from the people and personalities. The approach recognizes that systems of ideas are transferred in different ways, with many ideas transferred in conversations -- often at the bar, after formal meetings of the day have been completed.

### **3.2 Developing a curriculum for a new science of services systems leans on systems science as an entry point apart from existing disciplines**

One participant has been developing a base of knowledge in response to a call by IBM Research to develop a science of service systems, through an initiative known as Services Science, Management and Engineering. Others from the group had participated in a workshops in Tokyo, [at the Shibaura Institute of Technology in August 2007](#), and [at the Tokyo Institute of Technology in March 2008](#).

The challenge was to develop a master's level seminar for management and/or engineering students, based on an emerging science of service systems. In the absence of a clearly accepted and defined body of work, systems science was proposed as a foundation for systems science. An outline of ten topics -- appropriate for a 10-week or 13-week course -- was described and developed. In this case, the opportunity to be "on the ground floor" of a new science of service systems presents an entry point for graduate students to make systems knowledge relevant. The draft ideas from this discussion were further developed, and presented as [a paper at the ISSS Madison 2008 meeting](#).

### **3.3 Facilitating multi-faction negotiations on regional ethnic conflict has presented systems models as an entry point for sustainable resolution**

One of the participants has been working on an approach / method / process by which multiple factions (i.e. more than two) parties will engage in negotiations. Within Sri Lanka, there is conflict between the Sinhalese and Tamil Tigers, and identifying Tamil Tigers (alleged terrorists) amongst the general Tamil population is not obvious. The parties temporarily stop aggression during periods of negotiation, but talks break down and ensuing battles result in a lot of people die.

At the level of research, the systemic perspective of the Viable Systems Model has been applied to develop an approach for a sustainable resolution to the conflict. There is no question that this systems knowledge provides insight for the expert. Effective change requires, however, more widespread application of associated principles and techniques. Thus, the practical question as to appropriate depth of knowledge for on-the-ground facilitators -- as well as the negotiating parties themselves -- remains outstanding.

### **3.4 The development of skills and methods for analytical business professionals uses systems as an entry point to bridge hard and soft approaches**

Amongst professionals working in information technology, there is ongoing development of a role of business architects. Definition of this role has been prominent within the Business Architecture Working Group of The Open Group, the Business Architect Working Group of the Open Management Group, and within IBM Global Services. Individuals espousing the role of business architect generally possess both business and technical skills, and may play roles in consulting services, services delivery and/or sales.

The combination of designing both human systems and technological systems presents an entry point for systems knowledge. Many business architects come from prior experiences as IT architects, and are thus practitioners of systems emphasizing in the technology domain. While many with technical training may personally broaden their knowledge into the business domain through parallel training (e.g. MBA programs), there is an opportunity to enter through a common foundational level of systems science. In IBM, systems thinking has been named as a specific competency for the role, and training materials are available at a very high conceptual level. (Educational artifacts may date as far back as the early 1980s).

Within the standards groups, specification of business architecture skills continue to develop. In parallel, research into developing appropriate modeling tools is promising. The general spirit is to enable business architects with computer-based tools that ease the creation of diagrams and sketches with high precision and low detail. From this initial abductive representation, more rigorous modeling tools (e.g. for business process modeling, and/or architectural/technology modeling in Unified Modeling Language) used by technical professionals could be deduced and detailed.

### **4. How is the nature of systems knowledge coevolving with institutions (public, private, not-for-profit) and technology (wikis, blogs, voice over Internet)?**

The systems movement has -- at least -- a continuing legacy of 50 years of developing knowledge. While many of its ideas undoubtedly have durability, the relevance and presentation of systems knowledge needs to evolve with the times.

Reiterating "classic works" in systems theory is one way of educating the non-informed, but a purely academic pedagogy is not the only approach. Parallels can be drawn to the development of jazz musicians. Truly gifted musicians require little guidance, and can become virtuosos even without learning to read sheet music. A large number of musicians in college-level jazz programs come, however, from a long tradition of classical training. An approach that extends that training works from transcriptions of the works of great jazz musicians, and first mimicking them. The result is often classical musicians who are capable of playing jazz with the right rhythms, but really aren't natural in the genre.

An alternative approach to training jazz players is to break from theoretical knowledge (i.e. reading music). Instead, the feel of jazz is emphasized. The first lessons are on backbeat (i.e. playing on 2 and 4, instead of on 1 and 3). From that foundational intuition, students follow a more experiential approach to learning, neither denying or requiring classical foundations such as harmony and counterpoint.

In a parallel way, much of the writing in systems theory -- from the 1950s through 1980s -- should be revisited in the light of the contemporary world. Some ideas may be found obsolete, but other ideas may be reinforced and reintroduced to greater relevance.

#### **4.1 Messy social-economic-political issues are an opportunity for continuing development of systems knowledge**

Around the world, people are finding the pace of change in their lives to be challenging, if not overwhelming. Climate change is front page news. Jet travel, lowered national boundaries and ubiquitous information and communication technologies have made the world smaller. Simultaneously, there is pressure on resources as fossil fuels escalate in price, and systems providing of food and water are stressed.

In the search for alternative approaches to solving problems, studies such as *Limits to Growth* are being resurfaced. Many of their trends have come to fruition, illustrating a time lag longer than initial readers were prepared to accept. While all of us would prefer a world where these problems did not exist, they are circumstances where the "big thinking" of systemicists may be appropriate and helpful.

#### **4.2. Presenting systems knowledge to a new generation of thinkers represents a potential for another rebirth of the systems movement**

Technology changes -- particularly in Internet-based collaborative environments -- have led to a new generation of young adults who are more connected globally, yet are not engaged in the traditions of systems research. These are people who are probably not opposed to systems knowledge. They probably just don't know about it, and/or haven't found a need to apply it.

Internet technologies enable rapid and real-time communications that enables systems researchers to share and exchange ideas globally. The long history and breadth of systems research provides a wealth of theory available to practitioners, but those practitioners may have neither the motivation nor entry point into the literature for today's fast-paced world of people with short attention spans.

Mature systems researchers should find ways to bring these new ways into their practices, as opportunities to move the systems movement forward. Young adults and teenagers immersed in the global world of interconnected communications may be drawn into the systems movement by making systems research relevant to their contexts. The obsolete mindsets of long-time academics is annually compared with the mindsets of entering college students in the annual [Beloit College Mindset List](#).

For novices in the system movement, relevance defines the entry point into which systems practice and system research can enter. Three levels are suggested:

- 1. Systems concepts applied implicitly within a domain, using neither explicit systems vocabulary nor formal systems concepts.
- 2. Systems vocabulary explicitly applied in the domain, with additional meaning overloaded by a disciplinary context.
- 3. Systems foundations applied rigorously within a domain, by systems experts with a depth of understanding both in the domain at hand, and in the general isomorphisms across multiple disciplines.

Failure to make the systems movement relevant can be seen as a fault within the community, rather than a fault in the rest of the world who have never considered the difference that a systems view can bring.

#### **Epilogue: Our appreciation to the IFSR and the continuing Fuschl conversation**

With all of the preceding points on a changed world, these participants of Fuschl Team 2 acknowledge the continuing value of the Fuschl conversation, and its sponsorship by the IFSR. The Fuschl conversation, both in its setting and its style, represents an enduring institution in the continuing development of systems research.

As the world becomes faster, face-to-face communications in a loosely structured agenda has proven to be effective for post-graduate learning -- both at the level of individuals and in groups -- in an unstructured / emergent way. A large degree of diversity in participants is helpful in evolving ongoing work, and generating new directions and collaborations

In addition, artifacts of prior conversations are helpful as references for ongoing research. Ideas from a conversation in 2000 (i.e. on aporetic conflict) resurfaced in 2008, and are being revisited in current research. The path from idea generation to initial documentation to published research to application is ambiguous in its direction and duration. The combination of easily-accessible proceedings and in-person availability of prior participants improves the transmission of knowledge.

Interactions within small teams, with periodic reports and visits to other teams, represents an effective inquiring system where new ideas can be combined with an emerging network of ideas that continues to regenerate and refresh the systems movement.



## Topic 3: Disseminating, Accessing and Communicating Systems Knowledge

Herrscher Enrique (ARG)  
Blachfellner Stefan (AT)  
Chroust Gerhard (AT)

Hofkirchner Wolfgang (AT)  
Kalaidjieva Magdalena (BG)  
Ossimitz Günther (AT)

This topic is considered to be of high importance both to the IFSR itself, wanting to improve *communication* with and between its member societies and their members, and for the systems community at large, because of the *low density* of systems scientist in any one geographic location. It is considered essential to *spread system knowledge* beyond the borders of the system community to essentially *everybody*.

IFSR as a scientific professional organisation is searching for ways of any kind to support and stimulate the systemics & cybernetics knowledge itself and in all corresponding sciences

Modern information and communication technology allows approaches which were impossible even 20 years ago. At that time the paper copies of the IFSR Newsletter, 4 times a year arriving usually some 2 month *after* the submission deadline, was a key communication medium.

### The trigger questions

The team started from the trigger questions which were published with the Fuschl Call-for-Participation and refined in the discussions during the EMCSR 2008<sup>4</sup>:

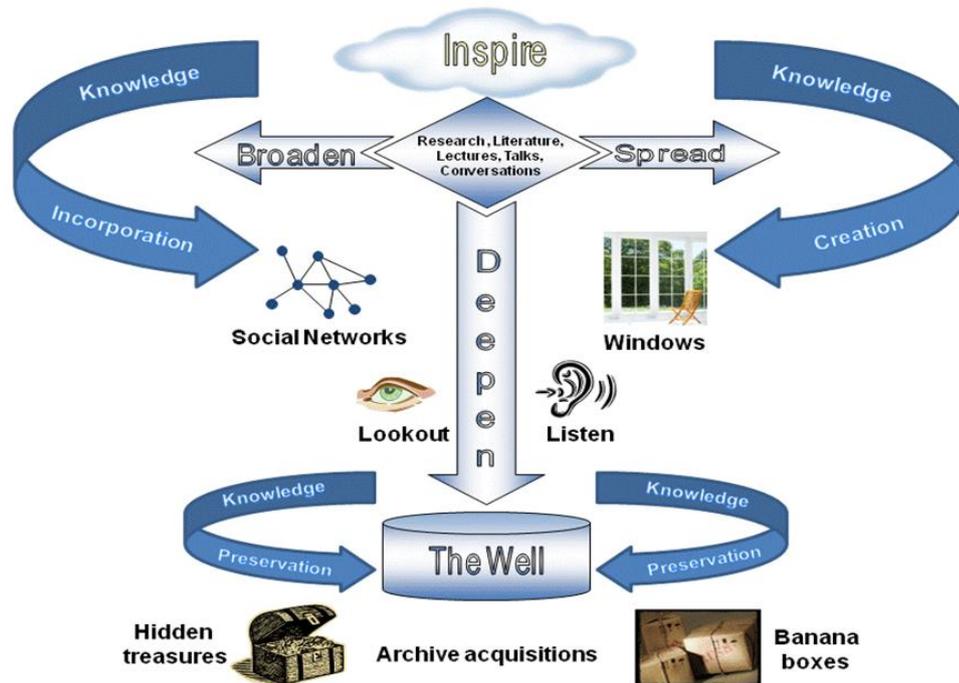
- How can we increase the accessibility of contemporary articles/books/journals on systems more effectively using modern technology ('*One-stop Knowledge Shopping*')?
- What kind of virtualization software can we employ, understand, and afford in order to provide accessibility to geographically dispersed publications ('*The Poor Man's Virtual Library*')?
- How can we preserve, analyze, record and make available publications of historical value and legacies of great systems scientists ('*The Systems Knowledge Archivar*')?
- How can we increase the dissemination of systems research ideas and achievements ('System Knowledge Distributor')?
- Can we conceptualize some recommender system, or assessment procedure to identify important publications ('Researcher's Scout')?
- Could we compile a catalogue of the locations of important systems materials ('Who is who of systems science archives')?
- How could we organize an information base to help people to find relevant information and pointers, given our limited resources ('*Yellow Pages of Systems Sciences*')?
- Can we provide an interface to the various catalogues and databases without undue visible technology ('The Dummy's Interface')?
- How can we get advance notice ('*Early Warning System*') and react quickly ('*Emergency Safeguarding*') when some legacy is in the danger of being dissolved or destroyed in order to preserve it?

<sup>4</sup> Chroust, G. and Drack, M. and Müller, K. H.: Vienna - The Systems Archive - Dream or More? pp. 595-599, Gary Metcalf: The Evolution of Conversation pp. 610 - 613 , and Christian Fuchs, Wolfgang Hofkirchner, Celina Raffl, Matthias Schafrank: The Web as Techno-Social System: The Emergence of Web 2.0 , pp. 604 – 609, all 3 papers in

Trappl, R. (ed.), Cybernetics and Systems 2008, Proc. European Meeting on Cybernetics and Systems Research 2008, Austrian Society for Cybernetic Studies, Vienna 2008, ISBN 978-85206-175-7

## The Metapher

### DISSEMINATING AND PRESERVING SYSTEMS KNOWLEDGE



Starting with basic questions of the function of systems archives, we identified (see diagram) three essential directions:

- Broadening the knowledge
- Spreading the knowledge
- Deepening and founding the knowledge by archiving it

A basic distinction was identified between 'the deep well' (detailed information to be preserved for the future), the 'spread' of concepts by distributing them to the (larger) systems community and the public in general, and broadening the knowledge by new discoveries.

The most common problem in disseminating and preserving knowledge is the fragmentation of the new and the old knowledge bases, some of them hidden or difficult to access. In most cases there are people dedicated to the *preservation*, e.g. archiving, creating encyclopedias, etc. There are people who use these knowledge bases to apply it in research, lectures, talks, conversations, and applications. Others broaden the knowledge base.

In the chosen metaphor, how does inspiration trigger spreading and broadening? Would it not be fascinating to incorporate the ongoing created knowledge in the well, again? And would it not be worth to gather our efforts to create a system that is in a sense living, co-evolving, recognized as a valuable source of wisdom, for theoretical as well as practical problem solving?

We talked about the power of social networks and the creation of - a metaphor again - *windows* for *people to look into* the system of systems science and also most necessary the same windows for *systems scientists to look out* (mainly digital tools to guarantee open access). Questions still remain and should be further discussed:

- Can we somehow support these social gatherings?
- Can we bridge generations and schools within the already fragmented field of systems science? We have to recognize that after a certain period of time, e.g. when those who created and those who apply a knowledge base are separated by age/generations, one can

witness the separation of two parties. The youngsters think the elders are talking about dead material, the elders think the youngsters are talking about applications they do not understand anymore, and feel being misunderstood or misinterpreted. Prejudices follow.

Should we preserve this field of knowledge from being forgotten, not only in our societies but also in our universities? Is this purpose reasonable?

*In the rest of this paper the metaphoric diagram is used to organize and position the various subtopics which were discussed in more detail in the team and with members of the other teams.*

## **Teaching and Dissemination of Systems Ideas**

With respect to disseminating systems knowledge we discussed various possibilities. A key question is 'deep' versus 'wide': We agreed that there is some variety needed (similar to Ashby's requisite variety) to cover different needs, especially when considering the needs, interest, and usage of the experts and non-experts.

With respect to the 'WHAT': What should we disseminate, what is relevant? Three types can be distinguished?

A) Classic knowledge,

B) knowledge emerging from A) and B) C) Upcoming issuers "leaving the door open".

The question of publication channels for system publications, especially systems books has also to be addressed

An interesting approach for IFSR could be to disseminate information via Wikipedia. This could be a community effort of IFSR.

Special attention has to be paid to countries and geographic regions, where any scientific information, including systemics & cybernetics, is 'out of reach', where single scientists struggle to get links to colleagues, who could in their leisure time send a valuable link or make a present of one book or university textbook. This is a part of the 'deepening', 'listen' and 'lookout' activities.

This sounds like a fairy tale from the 17th or 18th century. To my knowledge in those days dissemination was very slow, but more evenly possible with respect to geographical location. Nowadays vast regions are cut off of knowledge (and start doing lots of 'nonsense' socially or else). Information society is a fact, but knowledge dissemination stumbles far back.

In this respect, the IFSR may forward a professional *statement of necessity and appeal for generating ideas* how to proceed on all different levels of human responsibility, will and commitment.

## **Non-scientific Dissemination of Systems Ideas**

Basically the scientific systems community knows how to disseminate ideas to their scientific peers. But if one wants to *spread the ideas* beyond the systems community, one has to go to other audiences, and has to use other ways of dissemination.

The issue of 'non-scientific' means of dissemination was discussed: what about fairy tales, games, comic series, cartoons etc. This could be one objective for the IFSR in 2009/2010. Can one compile a list of 'Systems Games'?

Another approach could be film: the IFSR could offer a competition and a price for 'understandable ways to teach systems'.

An annual workshop on Visualization of systems concepts could be an interesting approach. BUT for that we definitely need communication and media experts.

Pedagogical principles for teaching systems thinking are essential.

Which systemic ideas can be understood at what (earliest) age, e.g. before scholarly education has spoiled intuition? What metaphors of any 'technical support or image' could we put into the node 'Research, Literature, Lectures, Talks, Conversations' or into 'The Well', which will become a symbol for otherwise very complicated concepts, having a bunch of definitions each – in order to make the 'Windows' efficient?

A short discussion with respect to teaching was devoted to the idea of a 'Vienna Systems Path' where visitors could both see the historic buildings and access the archives and libraries.

Obviously all these projects cost money, a business proposal has to be made.

## National Languages

Discussing these topics also brought about the question of language: English is only one of the world-wide languages; Spanish, Chinese, Arabic and others (like Russian) are also a key language.

While experts developing systemics & cybernetics as science and human knowledge domain, in many cases need the original text in its original form in order to comprehend the way the original author thought and presented it, for many of the purposes mentioned above, and future tasks mentioned below: we need *derived documents* in national languages.

The derived documents may be *plain direct translations* for research and university teaching.

Whereas for the purposes of knowledge dissemination towards officials in all three state powers (legislative, legal and executive), towards school and professional schools education, towards the whole domain of culture for a broad population using one and the same language (e.g. German speaking community<sup>5</sup>) several other "*dissemination products are needed*".

Disseminating systems knowledge into other national or regional languages cannot be qualified as non-scientific, because it lives on both sides of the borders between *scientific, popularising scientific and non-scientific*. The second issue will also be commitment to enlarging the number of people willing to contribute to systemics and cybernetics in any way, willing to apply it in their everyday lives and environments – which may have a great impact on local misunderstandings or even conflicts.

Methodologically and technologically it is a *narrative about science achievements* – be it in historical sequence, or in connection of some other domains of skills or knowledge. It requires special abilities and *teaching talent* together with the very deep understanding of systemics and cybernetics, whereas scientific 'core' creativity is less required. *Inventiveness* is needed more in the educational methods, tools for illustrating, exemplifying and many others of this kind.

This *popularising scientific activity* will have to override the geographical gap between excellence science centres and the so called 'developing regions' and through it support their development. In this respect, systemics & cybernetics has a *missionary role in one step before other sciences*. The IFSR could support them by proposing peers and peer reviewing for the texts, (lectures) presentations, multimedia products, etc.

Who is able and willing to participate in the translation, not only to European languages but also e.g. to Chinese and to Arabic?

This is the question to start with for compiling a bi-lingual list of experts.

On behalf of the IFSR we have to postulate: It is the challenge of the language community to translate *into their language* -

Time and cost have to be carefully considered.

But in many other ways the IFSR, its member organisations and, we are sure out of our own experience, all systemics & cybernetics scientists all over the world are willing to take part in disseminating this valuable domain of knowledge.

At the moment part of the problem is the lack of adequate bilingual dictionaries for language pairs.

IFSR could be very helpful, e.g. by keeping lists of multi-lingual persons to help in translations. It could also communicate with institutes, universities or organisations, who are willing to put on the agenda of their research and knowledge dissemination activities such projects concerning their staff or collaborative teams; could support them by proposing peers and peer reviewing for the texts, (lectures) presentations, multimedia products, etc.

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<sup>5</sup> Note by M. Kalaidjieva: The topic of disseminating systemics & cybernetics knowledge was among others discussed at the "Berliner November 2008" and in connection with the European Programme "Lifelong learning" and the project ERASMUS-EUROMEDIA.

The European project ERASMUS-EUROMEDIA from the European Programme “Lifelong learning” is only one of the many indirect possibilities. There are many more

The European project ERASMUS-EUROMEDIA from the European Programme “Lifelong learning” is only one of the many indirect possibilities. There are many more – e.g. we also discussed of how to convey systems knowledge to children by means of a ‘children’s language’, as Günther O. Ossimitz showed in his book<sup>6</sup>).

All this is part in all three main ‘branches’ in our basic metaphor: Inspire, Broaden and Spread, the latter one - literarily

### **Access to key publications and documents (,the Well')**

Of great concern is the access to rare, difficult to get, fundamental publications. Of similar interests are legacies of famous systems thinkers. The material (if rescued at all) is very often only available in ‘banana boxes’ with out index, analysis, etc. The material is also often dispersed over the world: parts of Stafford Beers legacy are kept in Liverpool, Toronto and St. Gallen, a model of his Operations Room can be seen in Karlsruhe (<http://www.metaphorum.org/>).

For researchers (especially newcomers) some kind of recommender system (“persons having read this were also interested in reading ...”) would be helpful.

### **Encyclopedia**

Charles Francois’ “Encyclopedia of Systems and Cybernetics”<sup>7</sup> is a typical representative of the ‘Well’. The IFSR’s has the intention to preserve this heritage, to make it available to a broader audience, and to augment it (ESCO-project). It is a very specific example of a key reference document.

Referring to it allows this discussion to be based on a real scenario, asking many of the questions and identifying problems.

The following questions have to be resolved

- In order to keep the encyclopedia alive we have to add new information (We should avoid to ‘become experts in dead horse riding’, including the question how to recognize a ‘dead horse’)
- Different ways of adding new material:
  - ‘democratic’ analog to Wikipedia
  - controlled, e.g. checked by experts
  - by invited specialists
  - only via a committee of experts
- Quality criteria and assurance: a lengthy discussion arose about how to organize such a project, especially with respect to the quality criteria,
- Language issue: how could the Encyclopedia become multi-language (there is especially much interest in a Spanish version!)
- How to compile at least a multilingual list of terms with ‘official’ translations. Note that part of the Encyclopedia was initially in Spanish!
- What should the architecture be? We estimate that there are at least 100 basic concepts (with lots of variants) – The Encyclopedia has (guess!) some 7000 entries on some 700 pages.
- Possible pricing structure and philosophy (Saur is a commercial enterprise!)
- How to screen in puts (treasure vs. trash)
- How to both preserve and enable ‘easy regression to’ the original contents.
- How to keep it up-to-date and arrange with the owner of the copyright, Saur Publishers in Munich.

In this context also the ESCO project gains importance.

Some ways of keeping the Encyclopedia alive could be (always assuming a reasonable agreement with Saur publishers).

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<sup>6</sup> Ossimitz, G.: Entwicklung systemischen Denkens. Theoretische Konzepte und empirische Untersuchungen, Profil Verlag, 2000, ISBN 389019494X (in German)

<sup>7</sup> Charles Francois: International Encyclopaedia of Systems and Cybernetics, s, K.G.Saur, München 2004, 2nd edition, 2 volumes}, pp. 737, ISBN 3-598-11630-6

- We would need an INSTITUTION other than the IFSR to be in 'operational' charge – IFSR itself does not have the organization for that type of work
- Cooperate with other encyclopedias (which are they?)
- Outsource the update to a university
- Apply for grants to finance it

We thought of an online project, perhaps like a Wikipedia. A discussion followed about the differences between lay and expert knowledge and the quality of the contents produced by "everybody".

## Key Tasks

Some further key tasks to be tackled are

- Spread the word about systems sciences.
- Teach systems ideas
- Perform Research
- Create a living system of systems and cybernetics knowledge
- Identify application possibilities of the Well:
  - ethical and social issues
  - ecological issues
  - political issues
- Provide archival storage and preserve legacies
- Establish Legacy scouts
- Design appropriate interfaces to archives
- Manage the "windows" to the systems knowledge (see diagram) for insiders and outsiders
- Use and interconnect between different national languages (especially Spanish!), defining the precise (?) meaning of terms and the evolvement of connotation over time
- Create a list of bi- and multi-lingual scientists interested in systemics & cybernetics to form later a sub-community interested in knowledge dissemination on all levels from scientific to plain language symbolic
- Examine financial considerations

Suggestions for the next step are:

- Continue the work on an electronic version of the "International Encyclopedia of Systems and Cybernetics" (ESCO)
- Attract young scholars
- Announce multi-lingual networking interest
- Engage as many people as possible as readers as well as producers of systems and cybernetics knowledge and its applications
- Reach out – give systems science theory a voice (again) in diverse transdisciplinary studies and in our societies.
- Experiment with unorthodox means of 'spreading' systems ideas via films, cartoons, interactive interfaces, (perhaps sponsoring a competition).
- Define the internal and external (visible) structure of the knowledge base.

## Systems Body of Knowledge: This Is Where Communication And Education Meet

Enrique G. Herrscher (Argentina)

One of the best ways to **communicate systems** is to **teach systems**. Not only does the teacher communicate to the learner (and vice versa, in the interactive mode) but also the learners communicate (hopefully) the “learned” to other people.

In the teaching process is where the “systems body of knowledge” (team objective Nr. 5) gets consolidated. It is therefore inevitable that – irrespective of each one’s team – we consider the teaching and learning of System Science a sort of “attractor issue”, where our particular theme gets its systemic perspective.

This discussion paper is meant as a continuation of Günther Ossimitz’ excellent questions and ideas about how to design an introductory systems course on university level. Given the Education theme’s centrality, I would venture to add some ideas that may complement his, derived from three additional questions and some minor ones.

### Some elements of systems teaching

#### First: should we focus on teaching or on learning?

Those are parts of one single and complex process, but comprise two issues: from the teaching and from the learning perspectives. A basic systemic thought is that societies and organizations should be learning societies. Let me add as a footnote that we ourselves should adopt mainly the “**learner**” mode rather than the “**knewer**” mode. The “knewer” category<sup>8</sup> is implicit – whether we like it or not – in the teacher’s role, and assumes that “we know”. However, given our changing world and its complexity, it may be advisable to be “learning communicators”. In the educational arena, we should try to be **more “learning teachers” than “teaching teachers”**.

This notwithstanding, it should be pointed out that this Discussion Paper will deal with the teaching side. The learning part may be more important, but it involves pedagogic, psychological and neurolinguistic aspects for which I am not sufficiently qualified. Whereas about teaching I can draw upon a long experience and may offer some pre-Fuschl ideas that may be improved or changed after Fuschl.

#### Second: should systems thinking be “neutral” or should it be also a platform from which to promote certain values?

By “neutral” I mean the **descriptive** mode, as opposed to the **prescriptive** mode of the alternative. Note however the term “also”: both modes complement each other. But note also that, even if only a minor part of a program, values may be most important: they are, in my view, the key to our aim of putting Systems at the service of Society.

Our pro-value-laden teaching orientation may seem to contradict the Nr. 3 point that follows. This is not so. Note that we will refer to “what the client **needs**”, not what s/he “**wants**”. Our “marketing attitude” will require both, but our “service to Society attitude” will favor the former.

The philosopher of science Mario Bunge<sup>9</sup> draws the line between science and technology, among other factors, according to whether the main objective is “truth” or “usefulness”. He sees the truth-seeking

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<sup>8</sup> I owe the term “knewer” to Brian Hinken’s article “How Learning Works” in *The Systems Thinker*, Vol. 18 Nr. 7, September 2007

<sup>9</sup> Mario Bunge (1981) *Teoría y Realidad* (Ariel, Barcelona). English original: *Theory and Reality* (1972)

science as value-free, while technology, geared towards its use, would be value-laden. Would we adopt this classification, Systemics<sup>10</sup> would be a technology, not a science.

I disagree, first, because science should also consider values, and second, because the “science – not science issue” seems more a matter of prestige than of true relevance. What does seem relevant is **the importance of values for students and business**. Moreover, it is better to include values explicitly, not hidden behind a questionable “objectivity” (remember Heinz von Foerster’s dictum: “objectivity is the illusion that there can be an observation without an observer”).

### Third: should there be a systems program that “fits all”?

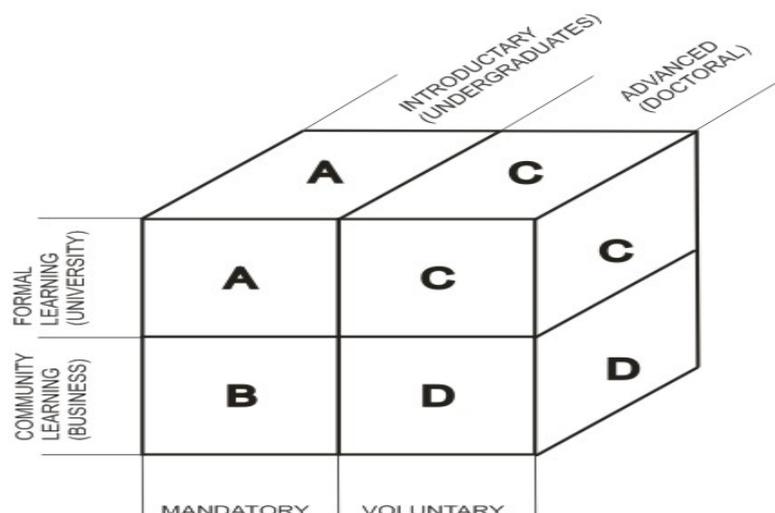
One thing is to have a “standard” or basic program from which to adapt specific instances according to the characteristics **and needs** of the learners, the “clients” (in Checkland’s CATWOE terms), and another to present to all of them the same program. The former is what GESI<sup>11</sup> and its honorary president Charles François is constantly working on, and possibly is what Günther Ossimitz had in mind with his 12 modules.

The point is that when designing specific programs the identity, age, background, experience, desires and above all needs of the learners should be considered. This leads to several connected questions:

- who will be the “clients”: university students (undergraduate, graduate, doctoral?) or entrepreneurs / business persons, or the general public of a city or region?
- will the teaching be a regular course, a prolonged seminar, a short workshop or a single lecture?
- will it be a curricular mandatory activity (all must go), an elective option (students must choose from a menu, and may choose systemics) or a voluntary opportunity (come if you are interested)?
- does the activity stand alone or is it part of a larger program (as for instance an MBA or a doctoral program)?
- if part of a university degree or a professional updating program: what professional career are the students studying or the professionals working in?
- would this be an introductory or an advanced course?
- to what degree would the learners (or – in the case of business training – their bosses) participate in the design of the activity?

### The teaching matrix

According to some of the above possibilities (simplified to only three dimensions), the following schematic matrix may be constructed:



<sup>10</sup> Note that I use the term “systemics” referring to the **body of knowledge** of our subject (similar to “economics” as opposed to “economy” as part of reality), while “systems” is the **category** we deal with, and “systemic” is our kind of approach.

<sup>11</sup> Grupo de Estudio de Sistemas Integrados, the Argentine chapter of ISSS

The following four cases could be described as typical examples. They are not meant to be “prototypes” but to show different possible approaches. Anyway they would have to be adapted further to the specifics of each learning situation:

**Case A: introductory, mandatory, university course (undergraduates and graduates)**

For this case, the “standard” version, such as Günther Ossimitz’s 12 modules, or the – very similar – program designed by Charles François and delivered several times at GESI could be used, adapted as required. Basic reading could be: J. P. van Gigch (1974) *Applied General Systems Theory* (English or Spanish), G. Minati and A. Collen (1997) *Introduction to Systemics* (English) and E. G. Herrscher (2003, 2005, 2006) *Systemic Thinking – walking the change or changing the road* (Spanish),

**Case B: introductory, mandatory, for business (in-company courses or seminars /workshops/lectures for entrepreneurs)**

In this case, the activity should be more practice – oriented and perhaps not called “systems” at all, but centered on a specific business function, such as Planning, Budgeting, Human Relations, etc. These subjects, with strong systemic contents, will allow a much easier acceptance than a “purely systems-based” approach.. Reading will not be significant (business persons rarely have reading habits) but they may be attracted by non orthodox approaches, such as B. Oshry’s *Seeing Systems* (1995) or M. Maruyama’s “mindscapes”, or by systemic approaches to specific business areas, like E. G. Herrscher’s *Systemic Planning in turbulent times* (2005, 2008, in Spanish).

**Case C: advanced, voluntary, university course (MBA, Doctoral)**

In this case, courses should be eminently interactive, based mostly on “learning by doing”, with less explanations by the teacher. A brief recap of basic concepts, as per Case A models, should be followed by practical exercises, as for example team work explaining to a political leader, the director of the local hospital, the rector of the University and an important business person what systemics is about.. Reading is paramount: mostly the systems classics: Ackoff, Ashby, Beer, Bertalanffy, Boulding, Jackson, Laszlo, Miller, von Foerster, etc. and above all, as key research guide, Charles François’ *International Encyclopedia of Systems and Cybernetics* (2004, 2<sup>nd</sup>.edition)

**Case D: advanced, voluntary seminars or workshops for the community (open to the public)**

In this case, activities may be short but rather intensive, often oriented towards a specific problem area, such as regional development or sustainability, where contradictions between the growth of a sector (industry, tourism, forestry, etc.) and its cost in terms of ecology, equity and/or social values are significant. In these cases, the leading concept may not be “systemics” but “complexity”, which is where the need of the systems approach originates. The programs should lean heavily on dialogue, consensus building, variety, multiple dimensions and transdisciplinarity, as well as on System Dynamics tools to show evolution over time. Advance reading of works where systemics’ impact on society is highlighted, such as Banathy, Checkland, Churchman or Schwaninger, and works teaching System Dynamics tools, as well as a multi-dimension problem-solving attitude, are essential.

## Hierarchy Theory as a Mediator towards Systemics – an Example of Education and Innovations

Magdalena A. Kalaidjieva (Bulgaria)

### Introduction –Dynamic Systems of Education and Science Creativity Processes

The *education system* of society is engaged in personality development within the interpersonal relations, it receives input from the science system outlets towards society and teaches among others the ways of discovering new knowledge as a game on already well known pieces of it, sometimes using historical stories, sometimes pretending to discover something – in order to let the new human generation learn in full this most complicated profession. The most important responsibility of schools and universities for the future of a society is to find out inborn talents and teach them to meet the requirements and become the new generation. The education system has to meet the requirement of contemporary society for a critical mass of knowledge.

*Critical mass of knowledge* of a society is a portion of a (local, regional or global) population, who are able to keep contemporary technological equipments within the limits of sustainable functioning. These human carriers of critical knowledge carry also the total responsibility for the technological security they are attached to. They are the direct mediator between power of Nature and human society. Hence, they have to and do get all kind of support, where they live with their families and for the network of colleagues, by the local authorities, who are more or less networked on all levels of power and societies forces.

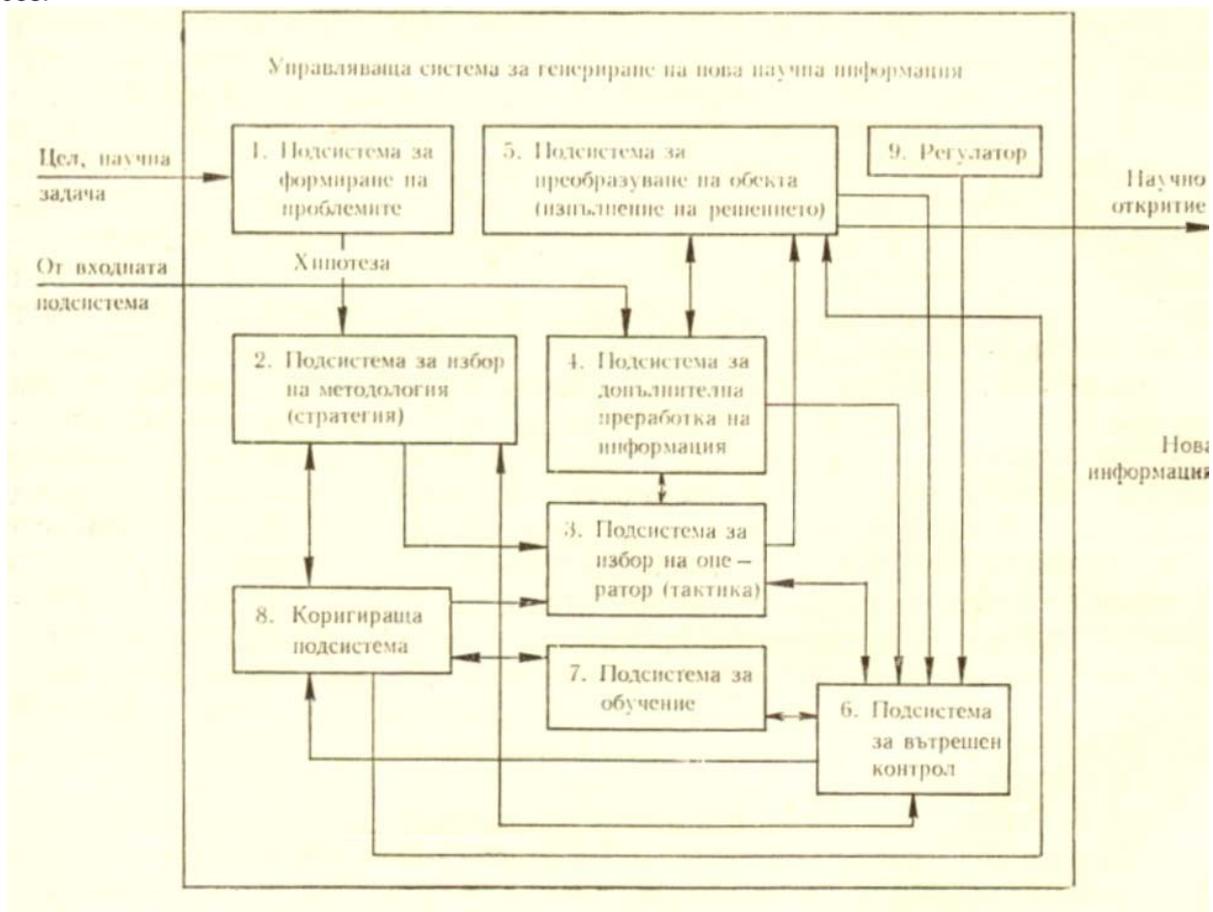


Figure 1. Management system for generating new scientific information

This number of educated people can function sustainably only, if this same (local, regional or global) population encloses (the collaborations of) a (much larger) number of persons ensuring the sustainable development of humanity. In this respect, the larger supra-system or the global one may, and nowadays it does, build a network sharing the mass of knowledge needed to sustain the local or regional

subsystems. In the end effect, the global one possesses the whole amount of knowledge needed not only for sustainable existence, but also for sustainable development.

The science system of humanity has always functioned globally. E.g. the 'iron curtain' had no effect, no constraints onto nuclear research and technologies. Knowledge sharing is as inborn as inquiry talents. The knowledge sharing among scholarly centres and educational 'units' of organisations formerly proceeded with the speed of boats, ships, horses, then railways and nowadays – in the Internet, World Wide Web and among a vast number of intranets.

*Sustainable mass of knowledge* of a society is a portion of a (local, regional or global) population, who are the biological carrier of contemporary knowledge, are able to reproduce the new generations both of the critical mass of knowledge and itself, and can generate new knowledge, in order to meet the requirements of the society for sustainable betterment of health and wealth, and of its own inquiry talents, needs and demands.

The world system of science and education is generating and forwarding new knowledge. Therefore, it is a starting point of this investigation. The scientific creativity process as a complex dynamic process within the system of science concerns:

- Human intellect, knowledge and science methodology,
- Stimuli and constraints on the road of personality, creativity and innovating,
- Factors and membranes.

The *dynamic system of the scientific research and creativity process* embraces the human intellect and human being and her/his development throughout the process, her/his processing the object of investigation and development of methods, tools, materials, etc., for it; as well as the result of his/her performance, both material and the immaterial knowledge about it, and their transformation from one step to the other in the dynamic of generating or emerging of new knowledge.

K. Kostov (1976) describes the system of the scientific research and creativity process as consisting of subsystems deployed in layers according to contemporary the top-down governing hierarchy model (which distorts the methodological and technological sequences shown by the numbering): 1) Forming the problem, 2) Choice of methodology (strategy), 3) Choice of operator (tactics), 4) Additional information processing, 5) Transformation of the object (executing the solution), 6) Inner control, 7) Training, 8) Corrections, and 9) Regulator. The final scientific output product enhancing human lives, may reach the society via three different outlets – *knowledge, progress in education and economic growth for quality of life* = 'health and wealth'. The outlet towards knowledge re-enters the *sciences system* among others by scientific publishing both in restricted (e.g. journals, patents, etc.), in open access, in popular literature transmitting novelties to the broad public and into the sphere of culture. Thus, publishing disseminates the novelties throughout all segments of human society's general wealth of knowledge. Publishing articles, lectures, books in popular style is a supplement to the education by disseminating knowledge throughout the society, enhancing general public culture and supporting life long learning.

The world of the society system and population's expectations is another starting point of investigation and concerns the second and third outlet of science system. The education system comes into contact with the science system and interacts with it via several in- and outputs from its very core.

The *social and economy system* receives science output via innovations. Controversies and contradictions mark the relations of these two worlds.

## **Innovation and Economic Growth**

Innovations are products of human creativity and materialize new knowledge. Sometimes the concept of innovation is understood in a broader sense – introducing novelties into any practical activity and life conditions, i.e. introducing knowledge to life. It may foster prosperity, but it also may misbalance systems leading to (unforeseen) consequences. The emergence of unforeseen results in the social and economy system means a poor scientific efficiency, but may have other motivations, which are not a focus in this paper.

*Innovations*, as a part of material activity and a link between science and economy, convert knowledge into material wealth both for wellness of society and for investing in the scientific sector of it, who carries and develops knowledge as a whole system; among others it ensures genetic reproduction of 'knowledge carriers', i.e. especially talented humans. Innovations can be created consciously or may happen (discoveries), i.e. emerge occasionally. The great 'art of doing science' is to watch, see and grasp the chance. The innovative process is dynamically depending on conditions and intentions.

Often we observe economic growth for its own sake (e.g. surplus production and trade with drugs or weapons), but it is not productive for the progress of society – as anything pointless and imposed by violence, and necessarily leads to crises and catastrophes, which could have been avoided. The initial roots of the latter unavoidably lie in at least one mischief of the science and education system of about 20 – 30 years before the crisis happens.

### **Hierarchy Theory as a Mediator towards Systemics**

The theory of (general) hierarchies<sup>12 13 14</sup> investigates the skeleton of any system by describing its features and functions pointing to, but not calculating them. It is a tool to examine classes of systems before their quantitative simulation or control / management. It also allows to examine and experiment with groups (sets) of systems, if and how to control / manage them together for establishing some desirable stability, sustainability or productive equilibrium.

*Process hierarchy* can be understood as a general hierarchy oriented along the time axis and describing a real (complex of) process(es). This is useful for investigating especially complicated ones like these causing, supporting and tied in with innovations.

*Verification Process Hierarchy in the context of the scientific research and creativity process*: Each of the possible variants for the process is tested and verified by means of methods of proof in several turns, the result being attached to the node or connection verified:

- by means of simulating the real situation, environment,
- under the real conditions of the situation, environment,
- during long term experience,
- probabilistic assumptions, etc.

*Catastrophe Process Hierarchy in the context of the scientific research and creativity process*: Critical values, limiting conditions, etc. are evaluated for each node or connection, the result being attached to in the form of a vector:

- resources,
- (critical) constants of substances, objects and processes,
- constraints of technology,
- (compared with) preliminary assumptions or probabilistic values.

*Social hierarchies* are (static or changing) hierarchic relations in society. Within the scientific community they may or may not follow or apply management methods used in other sectors of society, and some of them transferred without sufficient care may harm the fine tuned mechanism of science.

### **Management Background and Hierarchies**

We will look at the interplay among two social ones – the *hierarchy of scientific titles and degrees* with the *hierarchy of institutional/company management* from the viewpoint of the process hierarchy of the scientific research and creativity process. These two are very narrowly interconnected in the science system. Therefore we will show them as one complex general hierarchy – the *merged scientific with management hierarchy*. A finer description of the invariant characteristics (IC) of this hierarchy can be put in words from the viewpoint of the manager or from the one of the performers following the instructions of the manager. The second one will be the *inverse merged scientific with management hierarchy*. As 2<sup>nd</sup> postulate for hierarchies says, the straight and the inverse are a couple with the same structure, but with the opposite direction. By describing the IC in plain words both social and methodological details become observable and allow even finer tuning of systems control or to understand tuning defects, i.e. deformations of the system.

The merged scientific with management hierarchy reveals 11 (relatively) simple ones. The inverse has the same ones in their opposite meaning. Intuitively I find that 7 of them are essential, the other 4 are closer tied to pure management skills and actions (and may here be left out). But their (eventual) presence has to be noted for the completeness of investigation. The simple aspects of decomposition, as shown in the two tables, reflect to a great extent the components of scientific research and creativity process, it is not done on purpose, but taken in brief from the employment requirements for research institutions.

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<sup>12</sup> Kalaidjieva, Magdalena A. *Heirarchy. Theory and methodology*. Publishing House of the Bulgarian Academy of Sciences, 1985, 256 pages (in Bulgarian)

<sup>13</sup> Kalaidjieva M. The general hierarchy: A method for analysis and synthesis of hierarchies and networks. *Cybernetics and Systems*, v. 28(2), 1997, 163–176

<sup>14</sup> Kalaidjieva, Magdalena A. Design and Analysis of Hierarchic Systems. –In: Mieczislaw Bazewicz (ed.) *Systems. Journal of Transdisciplinary Systems Science*, 6(1–2), 2001, 41–53

### Merged Scientific with Management Hierarchy

Invariant Characteristics	Definitions or Descriptions
Hierarchic Direction:	1) From higher to lower scientific degrees, positions (or titles) 2) From higher to lower levels of management positions
Aspect of Decomposition:	A) Formulating research; B) Attract team, organise and arrange research tasks; C) Organising research processes; D) Attract material, E) technical, F) Personnel and G) Information resources; H) Evaluation of presented solutions and I) Researchers (authors); J) Prepare research and K) Personnel policy
Elements:	Personalities
Connections:	Interpersonal relations
Nodes:	Persons working at the institution
Algorithm of decomposition:	There are two simple aspects: 1) According to the delegated authority 2) According to the natural talent and accumulated knowledge
Polyhierarchy:	Within the first one - no, authority hierarchies are only monohierarchies Within the second one - yes, according to the creative intellectual technologies
Polythematics:	Yes, there are two simple aspects of decomposition, thus, two simple hierarchies, overlaid upon each other
Measure:	There is a great variety of methods and methodologies to measure, assess individual features, quantities, abilities, etc.
Note: Any of the aspects A – K can be assigned to one of the quasi parallel directions. This reveals the difference between leader and management abilities of humans to defining tasks and jobs.	

A *complex aspect of decomposition* consists of two or more running down and expanding its structure more or less parallel; the finer the investigation – the more details may be extracted as separate simple aspects of decomposition.

### Inverse Merged Scientific with Management Hierarchy

Invariant Characteristics	Definitions or Descriptions
Inverse Hierarchic Direction:	1) From lower to higher scientific degrees, positions (or titles) 2) From lower to higher levels of management positions
Aspect of Composition:	Performing the research tasks as formulated: A) Proving the formulation of each task; B) Evaluating the basics of C) Materials, technical instrumentation, Information and D) Research team; E) Perform and go into detail; and F) Present the results to be evaluated as labour and G) Author's abilities
.etc. (not fully spelled out)	
Note: Any of the aspects A – G can be assigned to one of the quasi parallel directions. This reveals the difference between leader and management abilities of humans to defining tasks and jobs.	

### Creativity, Humans and Membranes

*Creativity* is an inborn excellence of the human being to make or invent something new, something that has never before been there. Sometimes, it is very strongly determining the personality and obvious for family, teachers and friends. Sometimes it is less imperative upon behaviour or obvious, but not necessarily less productive. And even if it is a medium ability, still the intellect must be developed, because it is a really precious and very hard to obtain extremely valuable asset of society. As in every other activity, it is hard to locate the “precious stones” and polish them to brilliants (without splitting – these are humans!). Hindrances and obstacles are not obvious. They are often misused out of egoistic, careerist and corrupt aims or motivations. They are attained frequently only partially until the end of an even brilliant scientific career, and, might be forwarded to the next generation like deformed (insufficient) genes “mutations”. The latter have an enormous negative impact on the society locally, regionally or globally. In order to reveal deformations, hindrances and obstacles we introduced a system of “indicators”. Understanding the need for its being dynamic and build out of highly complex elements –

we turned our attention to dynamic systems in biology, biochemistry and biophysics and chose the concept of membrane<sup>15 16 17</sup>.

## Membranes in the Scientific Research and Creativity Process

*Membrane in the context of processes (and dynamic systems)* is a local complex of conditions, which affects a system or an ongoing process; it is placed at the output of an activity or subsystem and at the input of the next one, but may affect indirectly the whole system. The membrane affects the behaviour of the going through complex agent, throughout the next activity or subsystem and some following ones cumulatively. A membrane controls the speed and facets of the complex agent going / flowing through it, i.e. it influences the local performance in the process. The membrane is an assessment construct within the whole. The impact of a membrane onto the agent going through and his behaviour may differ according to state of the membrane, on one side. On the other side, the membrane's state can be altered by the characteristics, behaviour or essence of the complex agent going through. In both cases there act outside factors. Membranes might be multiply used or placed among two activities or subsystems and polyhierarchically influence the whole system. Observations evoke that in one and the same placement usually act directly or indirectly several membranes.

This systemic concept of membrane generalises membrane's functions and properties from biology, biochemistry and biophysics. Comparisons are made during a long period of time on investigations of Kalaidjiev, Angel (1976)<sup>18</sup>, Segal, Jakob & Kalaidjiev, Angel (1977)<sup>19</sup>. A membrane may let the flow in one direction only or, depending on factors or other interventions, allow a re-flux. Significant discoveries and concepts related to the neural system by the Nobel Prize winners Daly, Henry (1930), Hodgkin, Allen & Hucksley, Andrew (1963) and Sherington, Charles (1897) were described by Yakimov, Naum in 1991. They were compared with the concept of process hierarchy as mirroring the nervous system structure and functions. The behaviour of the living neurons, the networks they build, while agitated, which then fall apart, when inhibited, correspond to all eight postulates of the general hierarchy, i.e. *the concepts of general hierarchy are biologically inborn in living beings<sup>20</sup> in their nervous system*.

Main role for the membranes' behaviour in the context of creativity, education and innovation and the results of the processes therein plays the human, the scientist and his resources. He uses creative intellectual or intellectual routine technologies. In the input of a membrane we find data describing the state and outcome from the previous subsystem, values of parameters, limits and constraints, logical parameters values. At the output of a membrane we see besides the previous also management decisions and modified parameters values for the generated variants of future actions in the next (sub)process.

*Membranes' mechanism in the context of processes* is the system build out of the interconnected, interdependent set of membranes intervening in a complex process.

## Membranes and Ethical Values

*Ethical values* also are indirectly present; they play an important role in this investigation. The output of the subsystem is an intermediate research result both knowledge-bound and material – a pre-mature state of the innovation. In this paper we will not discuss the motives, but the ethical values and the results. Like every human intention it may be complying with laws or violating them, i.e. criminal. The almost exclusive difficulty of research and innovation is that they work with the unknown, with the knowledge that has never been there, and hence, there can be no legal laws about it. The laws of Nature are in many cases also just assumed or not known at all. This is the major ethical difficulty going

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<sup>15</sup> Segal, Jakob. *Die Erregbarkeit der lebenden Materie*. VEB Gustav Fischer Verlag, Jena, 1958, 252 p. 114, Abb., 7 Tab. (in German)

<sup>16</sup> Segal, Jakob, Dornberger-Schiff K. & Kalaidjiev, Angel. *Globular protein molecules: their structure and dynamic properties*. DVdW, Berlin 1960, 150 p. (published in German 1961)

<sup>17</sup> Kalaidjiev, Angel & Segal, Jakob. *Die Struktur biologisch aktiver Eiweiße*. Humboldt-Universität zu Berlin, 1966, 238 (in German)

<sup>18</sup> Kalaidjiev, Angel. *Biological membranes and their models. A bibliography*. Center for Scientific Medical Information, Medical Academy, Sofia, 1976, 71

<sup>19</sup> Segal, Jakob & Kalaidjiev, Angel. *Biophysikalische Aspekte der multimolekularen Eiweißstrukturen. Koazervate. Membranen. Fasern*. George Thieme Verlag, Leipzig, 1977, 144, 57 Abb., 10 Tab. (in German)

<sup>20</sup> Investigated in detail in: Kalaidjieva, Magdalena A. *Analysis and synthesis of hierarchies and networks*. Academic Publishing House "Professor Marin Drinov", Sofia, 1995, 607 pages (in Bulgarian)

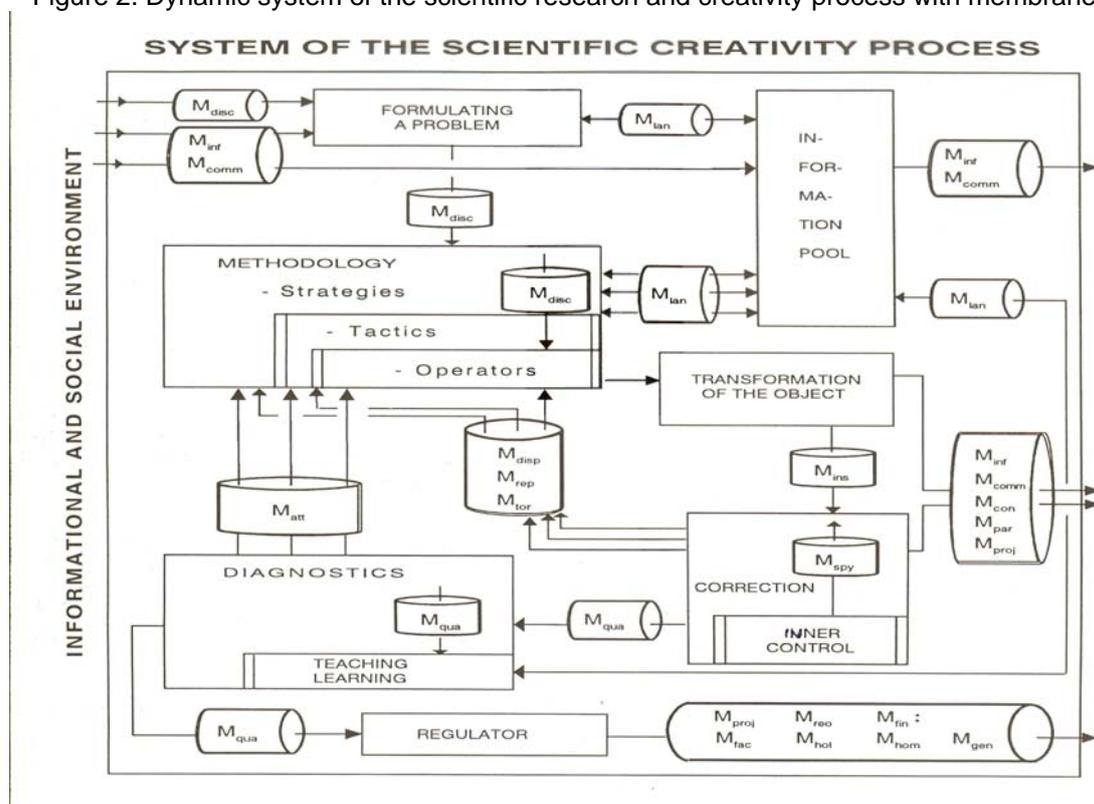
together with the highest possible complexity of proceeding. Therefore, ethical values play a special role in management of dynamically emerging innovations.

A *membrane in the context of processes* may be described in: a) Placement, b) Genuine or normal state, c) Pathological or deformed state, d) Consequences, e) Counter-deformed state (as response reaction), and f) Membrane variants and co-acting membranes at the same placement. A *genuine, deformed or counter-deformed current state of a membrane* depend on 'good- or ill-minded' intentions or on factors from in- and outside the process or from any element of society.

*Management in the context of knowledge, education and innovation* is a conscious, wilful and intentional intervention on one or several membranes by one or more humans, who might be researchers, or just managers, or non-certified non-educated outsiders, who happen to come in reach of the process geographically, locally, financially or else. The intentional intervention in the process of dynamically created or emerging innovation may aim at promoting or preventing it. History of humanity is rich on examples of both. Management gains a special role in the membrane mechanism also in context of education, because science and innovating are a life-long learning commitment.

*Responsibilities of the scientist* towards society, capabilities acquired by education, are to verify knowledge and warn about limits, constraints or dangers on the borders with the unknown.

Figure 2. Dynamic system of the scientific research and creativity process with membranes<sup>21</sup>



Abbreviations for membranes classes and sub-classes:

Classes	Sub-Classes	Name of Membrane
M <sub>INFORM</sub>		Information membrane
	M <sub>COMM</sub>	Communication membrane
M <sub>SHARE</sub>		Membrane of mandatory sharing
	M <sub>TRANSL</sub>	Interpreter and translator membrane
M <sub>CTRL</sub>		Membrane of control and testing experimenting
	M <sub>PARAL</sub>	Membrane of parallel investigation
M <sub>INSIN</sub>		Insinuation membrane
M <sub>DISC</sub>		Discipline command membrane
	M <sub>REPRESS</sub>	Repressive membrane
	M <sub>HOUSREPR</sub>	Membrane of the repressive working and housing environment

<sup>21</sup> from Kalaidjieva, Magdalena A. *Analysis and synthesis of hierarchies and networks*. Academic Publishing House "Professor Marin Drinov", Sofia, 1995, 607 pages (in Bulgarian)

M <sub>INNSPY</sub>	Membrane of the total company or organisation espionage
M <sub>ATTEST</sub>	Evaluations membrane
M <sub>QUAL</sub>	Qualifications membrane
M <sub>REFER</sub>	Reviewing membrane
M <sub>SECJOB</sub>	Membrane of the second job
M <sub>REORG</sub>	Reorganisations membrane
M <sub>FIN</sub>	Financial membrane
M <sub>MATTECH</sub>	Membrane of the material and technical research conditions
M <sub>RELAX</sub>	Membrane of relaxing and regeneration of creative abilities
M <sub>HOUS</sub>	Membrane of working and housing conditions
M <sub>GENET</sub>	Membrane of genetic reproduction

The influences of the membrane mechanism are superimposed throughout the whole process. That is, the output resulting at the end of each passage through any process or single step of it is a *superposition of the influences* experienced from the very beginning of the passage.

### Conclusion: Managing Decentralised or Independent but Networked Systems

The dynamic system of the scientific research and creativity process was chosen only as an opportunity to illustrate the concepts of membrane, classes and sub-classes of membranes, system of membranes and membrane mechanism, dynamic behaviour, as well as management of independent but networked systems.

The concept of membrane mechanism has been created to describe a novel original control tool for in process hierarchies. Investigated on its own, it is a *systemic multifaceted instrument for managing (manipulating) decentralised or independent but networked systems*<sup>22 23</sup>. It can be applied in a similar way to systems in any other knowledge domain or segment of society, e.g. onto the systemic economic relations. It is assumed that some of the membranes, investigated here as having an effect on the science system, will appear in a modified version or some more membranes will be configured for the economy system. However, those enumerated here will have positive or negative impact on the latter and on the wealth of society as long as the society is ruled by individuals and social ethics treasuring scientific knowledge as the highest value.

How the population of a society can understand and communicate with researchers, inventors, lecturers and innovators or how scientists from different knowledge domains do so among themselves, is not a trivial. A genuine methodology is needed. Long lasting experience has led to an optimal system of organising a personal working space and archiving, which has been implemented for personal computers. It supplements the investigations presented here.

*A mischief of the science and education systems necessarily leads to crises and catastrophes, which could have been avoided; they unavoidably happen about 20 – 30 years later and the new generation grown in the meantime usually can hardly trace back the initial roots of the disaster.*

Societies, who neglect intellect or knowledge are consuming and not providing wealth and can exist as long as they have where to take from for to consume. Therein, the highest priority of power may become the physical power, i.e. applying violence and violating human rights of (a portion of) the population. Both the number of educated and knowledgeable people and the quality of their education in such countries is below the critical mass and rapidly falling. The consequences are very far going as we could observe at the beginning of the new millennium.

Many countries in the modern world show this state of affairs to a different extent and in different constructs. Modern endowment of science can keep technology within the limits of sustainable functioning exclusively by a qualitative and quantitative level of highest intellect and educations that is above 'a sustainable mass of knowledge'.

<sup>22</sup> Kalaidjieva, Magdalena A. Multi-top decentralised hierarchic structures. Project Report, Sofia, 1988, 108 pages

<sup>23</sup> Kalaidjieva, Magdalena A. Centralised management of decentralised units, connections, structures. Examples and principles. – In: Kalaidjieva, Magdalena A., Hierarchic Analysis, Project Report, Sofia, 1990, 262 pages



## Topic 4: Quality & Excellence in Systems Research

María Mercedes Clusella (ARG)  
Marko Kiauta (SI)  
Alexander Laszlo (US)

Kathia C. Laszlo (MEX)  
Hellmut Löckenhoff (D)  
and *in absentia*, Matjaž Mulej. (SI)

Specific Topic of this Conversation:

### **Applying Idealized Systems Design to advance the International Academy of Systems and Cybernetic Sciences (IASCS) as an Evolutionary Guidance System**

Our team worked with the recently approved proposal set before the IFSR for the establishment of an International Academy of Systems and Cybernetic Sciences by Matjaž Mulej and Jifa Gu (for the original proposal, see *Proceedings of the 19<sup>th</sup> European Meeting of Cybernetics and Systems Research*, vol. 2, p. 614). It was our goal to provide a fresh look at how this magnificent, and now officially approved proposal that Matjaž and Jifa had worked so hard on crafting over the past three years, could be brought to life in fulfillment of its true potential. We focused our efforts on considering **how the Academy could be informed by the notion of an Evolutionary Guidance System (EGS)**. What would it have to do and to be in order to serve as the EGS for the IFSR — and in consequence, for the systems sciences considered as a dynamic transdisciplinary, trans-generational, and transcultural field?

One of the first things we realized is that if we were to design a way to vitalize the Academy as an open Living Institution, it would have to serve and co-evolve with its stakeholders. Otherwise, it would not operate in a way consistent with its mission, vision and values. This simple realization had tremendous implications. We were clear on the fact that failure to pay attention to it would make both the process and the outcome of our design ineffective and irrelevant.

In this light, the mission, vision and values that emerged from our consideration of the essence and potential of the Academy are as follows:

1. **Values Statement:** *Innovation and ethical interdependence are the core guiding values of the Academy.*  
We realized that innovation without ethical interdependence is blind, and ethical interdependence without innovation is lame. Therefore, these values must exist in a relationship of mutual causality for the Academy to be a Living Institution.
2. **Vision Statement:** *The Academy promotes the contribution of the systems and cybernetic sciences in the transformation of society.*
3. **Mission Statement:** *To foster dynamic collaboration among systems scholars and practitioners in order to cultivate and disseminate systemic insight, understanding and wisdom*

To achieve this end, the Academy would need to embody and enact the following three primary action principles of an EGS

- a. *servicing* its stakeholders
- b. *monitoring* emerging needs and opportunities
- c. *guiding* judicious use of systems concepts and practices

We realized that the mission, vision and values must also exist in mutual causality. That is to say, as the conceptual platform of the EGS, they form an integral and interdependent system, themselves.

Initial Considerations: During our Fuschl Conversation week, Team 5 opened a new possibility space for the ongoing evolution of the Academy. We generated initial ideas at the strategic and tactical level to complement the existing framework developed by Matjaž and Jifa and documented our work in a 34 page Extended Transcript report of our work sessions and a 4 slide Executive

PowerPoint presentation prepared for the broader Fuschl Conversation Community (both documents are available upon request).

We have begun the task of synthesizing the work undertaken during the week at Fuschl as it complements the existing approved framework for the Academy already developed by Matjaž and Jifa. In order to accomplish this, we have entered into a preliminary conversation with the primary stakeholders of the plans for the Academy. The first round of considerations has revolved around our postulation of the following **three possible outcomes** of this conversation:

1. Our efforts to cast the Academy as a Living Institution are embraced by Matjaž and Jifa and approved by the IFSR. Our recommendations are utilized to expand and enrich the function of the Academy as an Evolutionary Guidance System that evolves in dynamic interdependence with the IFSR, its stakeholder organizations and the living membership of which they are comprised.
2. Our conceptualization of the Academy is accepted as the basis for a complementary though auxiliary organizational unit that does not affect the strategy, structure or processes of the Academy itself. Instead, the aims and objectives (as briefly outlined in the mission, vision and values section, above) become incorporated in a linked but separate branch of the Academy.
3. The framework for a Living Organization is not seen as relevant or appropriate to the Academy, thereby creating the opportunity to present our design efforts as an independent and free-standing organization that operates in parallel, but not in association, with the Academy.

It has been our greatest hope and desire, as a Conversation Team, that Outcome #1 be realized. Failing that, we would hope that Outcome #2 could be agreed upon as a second best alternative since this point presents a scenario that is half-way between the optimistic and positive scenario presented in Outcome #1 and the least desirable and least synergetic scenario presented in Outcome #3. Only as an option of last choice would Outcome #3 be developed.

Part of the exchange we have begun with the primary stakeholders of the plans for the Academy have involved clarification of the implications of Outcome #2. To this end, we have sought to distinguish it from the scenarios described in the other two Outcomes. We have specified that, whereas Outcome #1 would mean adoption of the recommendations and orientations that Team 5 began to develop, Outcome #3 would mean rejection of those recommendations and orientations. Outcome #2 would therefore mean that the recommendations and orientations would not be used to inform the shaping of the Academy itself but would be used to create a sub-organization or branch of the Academy affected by the work of Team 4 while at the same time providing a means for our work to be associated with that of the Academy, even if only indirectly. We clarified that the notion of this being done through a "linked but separate branch of the Academy" was meant to indicate the semi-autonomous nature of the sub-organization, i.e., that it would work in association with the Academy but would not be meant to shape or influence it directly.

In these early discussions, we emphasized that Outcome #2 was not as desirable a scenario as that presented in Outcome #1, and that we very much hope that Outcome #1 will be come to fruition. Nevertheless, we are fully cognizant of the fact that which Outcome will result will depend on the dedicated and respectful consideration of all the members of Team 5 *together with* the primary stakeholders of the plans for the Academy. Fortunately, this conversation is already well begun. The key is for them to continue unabated now, with the voices of Hellmut, Kathia, María, Marko and Alexander in direct and ongoing interaction with Matjaž and Jifa.

The shaping of the future of the IASCS is well under way!



## Appendix: What is the IFSR?

### The History

A good half a century ago, right after the end of the dreadful period from 1914 to 1945 comprising World War I, the World Economic crisis, and World War II, scientists such as Ludwig von Bertalanffy, Norbert Wiener and their colleagues found a response to the terrible events that killed tens of millions of people: holistic rather than fragmented thinking, decision-making and acting. They established two sciences to support humankind in the effort of meeting this end, which is a promising alternative to the worldwide and local crises. These sciences were *Systems Theory* and *Cybernetics*. System was and is the word entitled to represent the whole. One fights one-sidedness in order to survive. Nevertheless every human must be specialized in a fragment of the immense huge knowledge humankind possesses today. Thus, one-sidedness is unavoidable and beneficial, too. But networking of many one-sided insights can help all of us overcome the weak sides of a narrow specialization. Thus, we all need a narrow professional capacity and add to it systemic / holistic thinking.

From this combination most modern equipment resulted, most modern knowledge in all spheres of human activity, solutions to environmental problems, etc. Most of the remaining problems can be ascribed to a lack of this combination, and there are many around that can hardly be solved without systems thinking and creative co-operation of diverse specialists.

Our responsibility for the future obliges us to try to improve the current situation and not to leave an excessive burden to future generation. The Founding of the IFSR

Since a system, in its general abstract definition, is more than its parts as well more than the sum of its parts, it was decided to interlink groups of system thinkers around the world and to try to find answers to some of the pressing problems of the world.

On March 12, 1980 during the 5<sup>th</sup> EMCSR-Congress in Vienna the three important societies in the area of systems research, the *Österreichische Studiengesellschaft für Kybernetik*, the *Systemgroup Nederland*, and the *Society for General System Research* founded the *International Federation for Systems Research*. The key persons were: Robert Trappl, George J. Klir, Gerard de Zeeuw. They became the first officers of the IFSR.

Strong support came from the then Austrian Ministry of Science and Research in the person of Norbert Rozsenich providing some financial support and Paul F de. P. Hanika, taking the responsibility of Editor in chief of the Newsletter of the IFSR.

### Aims and Goals of the IFSR

The constitution of the Federation states:

The aims of the Federation are to stimulate all activities associated with the scientific study of systems and to co-ordinate such activities at the international level by:

- co-coordinating systems research activities of private persons and/or organizations;
- organizing international meetings, courses, workshops, and the like;
- promoting international publications in the area of systems research;
- promoting systems education;
- maintaining standards and competence in systems research and education; and
- any other means ... [to] serve the aims of the members.

The first Board Meeting (June 1980) defined the Federation's goals:

- **Social Learning Goal:** Strengthen the programs of member societies by their involvement in the program and network of IFSR.
- **Membership Development Goal:** Facilitate (encourage) the development of Systems science in countries in which such programs do not yet exist or are now developing.
- **Synergetic Goal:** Develop – implement – evaluate IFSR-level programs to meet the purposes of IFSR to advance systems science.
- **Resource Development Goal:** Identify an inventory of system science relevant resources, acquire those and make them accessible to member societies.
- **Global Mission:** Make contribution to the larger (global) scientific community, be of service to improve the (global) human condition, and enrich the quality of life of all. The Growth of the IFSR

Many prominent system scientists have been officers of the IFSR since 1980

<i>starting</i>	<i>President</i>	<i>Vice-President(s)</i>	<i>Secretary/Treasurer</i>
1980	George J. Klir	Robert Trappl	Gerard de Zeeuw
1984	Robert Trappl	Bela H. Banathy	Gerard de Zeeuw
1988	Gerrit Broekstra	Franz Pichler	Bela Banathy
1992	Gerard de Zeeuw	J.D.R. De Raadt	Gerhard Chroust
1994	Bela H. Banathy	Michael C. Jackson	Gerhard Chroust
1998	Michael C. Jackson	Yong Pil Rhee	Gerhard Chroust
2000	Yong Pil Rhee	Michael C. Jackson	Gerhard Chroust
2002	Jifa Gu	Matjaz Mulej, Gary S. Metcalf	Gerhard Chroust
2006	Matjaz Mulej	Jifa Gu Gary S. Metcalf Yoshiteru Nakamori	Gerhard Chroust
2008	Matjaz Mulej	Gary S. Metcalf	Gerhard Chroust

In the 25 years of its existence, the IFSR has shown a healthy growth. It now counts 36 members, representing scientists from 25 countries on most continents.

The most recent list can be found on <http://ifsr.ocg.at/world/node/3>

## IFSR Activities

The IFSR pursues successfully numerous activities:

- *Systems Research and Behavioural Science* (ISSN 1092-7026), the official scientific journal of the IFSR, edited by Michael C. Jackson, published since 1984
- *International Series on Systems Science and Engineering*, IFSR's book series, established in 1985, edited by George J. Klir, now published by Springer, New York
- the yearly *IFSR Newsletter*, the informal newsletter of the IFSR (paper : ISSN 1818-0809, online: ISSN 1818-0817), published since 1981, edited by Gerhard Chroust
- The *IFSR* web-site (<http://www.ifsr.org>) informing the world about the Federation's activities
- *the IFSR Fuschl-conversations*, taking place every other year since 1982 in Fuschl near Salzburg, Austria, discussing issues of social learning
- Support for other events (e.g. the EMCSR-conference in Vienna every second year)
- Sponsoring a bi-annual Ashby-lecture at the European Meeting on Cybernetics and Systems Research (EMCSR)

## Future Plans

More than ever Systems Sciences are seen as a basis for balancing the divergent needs and interests between individuals and society worldwide, between ecology and economy, between nations of various levels of development and between differing worldviews.

The IFSR commits itself to increase its contributions answering the needs as expressed in its original aims and goals. Some new activities, in line with the needs and the challenges, have already been started:

- *The Bertalanffy Library*: In cooperation with the Bertalanffy Center for the Study of Systems Science (led by W. Hofkirchner) the IFSR will both help to preserve, revive and disseminate systems concepts and knowledge in general and L. v. Bertalanffy's ideas and work on General Systems Theory in particular.
- *ESCO - The International Encyclopaedia of Systems and Cybernetics* based on Charles Francois' seminal International Encyclopedia of Systems and Cybernetics. This work will be continued, supplemented electronically as an attempt clarify and reduce inconsistent terminology and semantics in the field.
- *The International Academy of Systems and Cybernetics* (led by M. Mulej) as a forum for persons professionally excelling in System and Cybernetics Research
- *Supporting our member associations* in organizing conferences and workshops

## Current Officers of the IFSR



President  
Prof. Dr.  
Matjaz MULEJ

University of Maribor,  
Slovenia

mulej@uni-mb.si

Vicepresident  
Prof. Yoshiteru  
Nakamori

JAIST - Japan  
Adv.Inst. of Science  
and Tech., Japan

nakamori@jaist.ac.jp

Vicepresident  
Dr. Gary S.  
METCALF

InterConnections LLC,  
USA

gmetcalf@  
interconnectionsllc.com

Secretary General  
Prof. Dr. Gerhard  
CHROUST

Kepler University Linz,  
Austria

gc@sea.uni-linz.ac.at

The aim of the Fourteenth Fuschl Conversation in 2008 was to continue the tradition that had been established, but with a renewed focus on coordination between the participating teams. The overarching theme for the conversation was systems research and education, and each individual team conversation fed into this. (This helped to overcome some of the diversity of topics, and the resulting difficulties in sharing of information that had developed over the years.) Importantly, this built on the ongoing work within many of the member organizations of the IFSR, e.g. the production of systems journals and archives, and the development of educational programs and courses. The outcomes of this conversation, while at a high conceptual level, supported further practical applications through individual member activities.

The Conversations basically followed the scheme used in earlier Fuschl Conversations as devised by Bela H. Banathy. 23 renowned systems scientists and systems practitioners from 12 countries took part in this 5-day conversation. The outcome of the conversation is summarized in 4 team reports plus several contributed papers.

Institute for Systems Engineering and  
Automation  
[www.sea.uni-linz.ac.at](http://www.sea.uni-linz.ac.at)

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